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RIPARIAN COMMUNITY TYPE CLASSIFICATION
BIG PINEY RANGER DISTRICT, WYOMING
For
U.S. Forest Service-Region IV
1982
(Authors:K.M.Mutz; R.Graham

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RIPARIAN COMMUNITY TYPE CLASSIFICATION

BIG PINEY, WYOMING RANGER DISTRICT

Meiiji
Resource
Consultants

Riparian Community Type

Classification

Big Piney Ranger District, Wyoming

Contract No.: 53-84M8-1-974

For

U.S. Forest Service

Region IV

1982

Prepared by:

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ACKNOWLEDGEMENTS

The authors would like to express their appreciation for the opportunity to conduct this riparian study.

We recognize the contributions of Al Winward, USFS, in organizing the study and guiding the fieldwork; Don Shute, a friend and fan of Salix for his early assistance in identifying potential community types; Mont E. Lewis, USFS Herbarium, Ron Kass, Brigham Young University, and Lois Arnow of the Garrett Herbarium for verifying plant species; USFS personnel of the Big Piney District for their general cooperation and John Carlson for his assistance in productivity sampling.

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INTRODUCTION

In spring of 1979 the U.S. Forest Service and Utah State University entered into a cooperative agreement to develop a community classification system for the riparian zone of the Grey's River area, Wyoming. The summer of 1979 was used for photo interpretation, field reconnaissance, limited sampling of vegetation and soils and various wildlife studies (Norton et al., 1980). In 1980 a full summer of fieldwork characterized vegetation and soils on several drainages of the Grey's River Range (see Figure 1). The 1980 report* (Norton, et al., 1981) refined the preliminary classification system of 1979, described soil characteristics and genesis for each community type (ct), conjectured successional relationships among ct's, and made management recommendations.

Forest Service management needs have prompted much of the forest classification work. Steele et al. (1979) points out that habitat typing (and we extend this to community typing) is designed as a natural classification, not developed for a specific need but suited to many purposes. Several community types might be combined for specific management purposes but are delineated separately at this stage. A more detailed-than-necessary system may be the result but is intended to prevent the need for resampling and reanalysis later.

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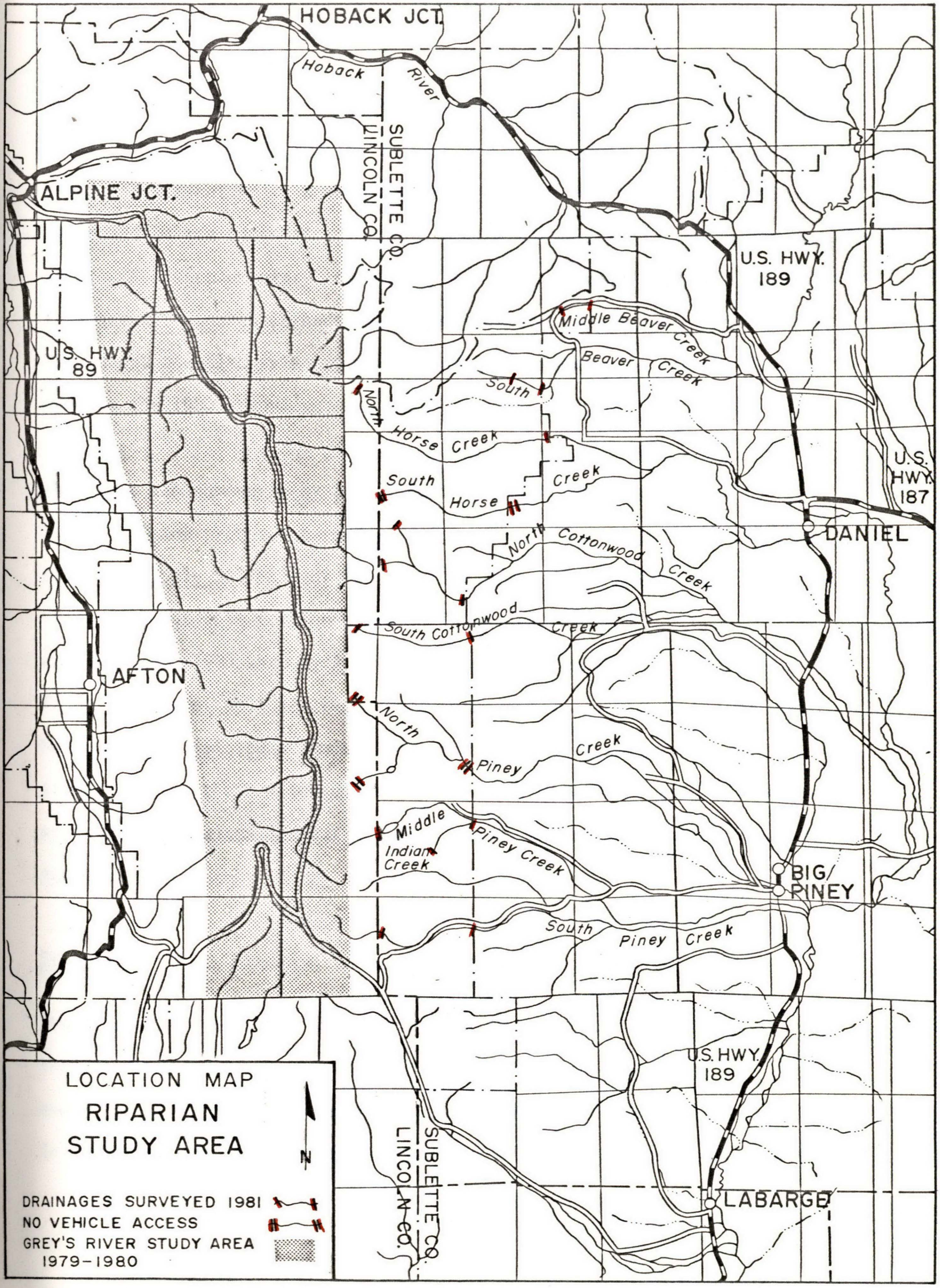
* Although the final report was submitted in 1981, we will refer to the Grey's River classification project as the "1980 project," "1980 classification system," "1980 report," etc.

FIG. I


HOBACK JCT.
Hoback
River
ALPINE JCT.
LINCOLN CO.
SUBLETTE CO.
U.S. HWY. 189
U.S. HWY. 89
Middle Beaver Creek
Beaver Creek
South
North Horse Creek
South Horse Creek
U.S. HWY. 187
DANIEL
North Cottonwood Creek
South Cottonwood Creek
AFTON
North Piney Creek
Middle Piney Creek
Indian Creek
BIG PINEY
South Piney Creek
U.S. HWY. 189
LOCATION MAP
RIPARIAN STUDY AREA
N
DRAINAGES SURVEYED 1981
NO VEHICLE ACCESS
GREY'S RIVER STUDY AREA 1979-1980
LINCOLN CO.
SUBLETTE CO.
LABARGE

The current project was conceived to supplement the 1979-80 classification work. Principal goals were 1) to test the applicability of the Grey's River classification to a separate system of drainages in the vicinity, and 2) to add to the classification any additional ct's found in the new study area. The "supplementary" nature of the 1981 riparian study greatly influenced research methods, data analysis and the format of this report. Throughout the discussion reference and comparisons will frequently be made to the 1980 study.

The study was commenced by accepting the 1980 working definition of "riparian" and proceeding to the field. "Dominance of obligate riparian plants" is only half of the two part vegetation-soils definition of "riparian" but this portion essentially guided the early reconnaissance work. During 1980 shrubby *Artemisia* spp. were specifically excluded from the list of obligate riparian plants. As indicated in the Methods Section, *Artemisia cana* communities were eventually included in this study. All of these sites did not fit the working definition of riparian soils which requires indications of a ground water table within 1 meter of the surface.

Study Area

The area chosen for this study is the Wyoming Range, immediately east of the Grey's River Range (Figure 1). Drainages which the Forest Service chose for study are titled and indicated with tick marks. These range in elevation from 2380 to 2800 m (7800 to 9200 feet). Drainages sampled

on the Grey's River and Wyoming Range areas are at times separated by less than 3 air miles over a ridge line of about 3475 m (11400 feet).

Climate of the study area should vary somewhat from the Grey's River Range since it is to the leeward side of the Wyoming Range. Although no long term weather stations are operating in the study area, data from stations east and west of the 1980 and 1981 study areas are compared in Table 1. We can infer that precipitation in the Wyoming Range is several centimeters lower than in the Grey's River Range. Temperatures may also be generally lower (USDC, 1980).

The 1980-81 water year was drier than normal and included less snow cover (person communication, tourists and Forest Service). Thin snow cover probably explains dead willow tops in some drainages.

Both the 1980 and 1981 study areas are associated with Wyoming's Overthrust Belt. The northern drainages of this project (North Fork of the Middle Beaver and South Beaver Creek) lie northeast of the belt of geologic disturbance in individed rocks of the Lower Eocene and Paleocene. Travelling southward the Forest boundary (usually the lower limit of the study area) approaches and finally enters the Overthrust Belt. From North Horse Creek southward the drainages are cut by one and sometimes two fault lines. In the geologically more complicated southern area, the creeks pass through up to six formations in less than 12 miles.

Table 1. Climatological Data

	Mean Precipitation cm (inches)			Mean Temperatures °C (°F)	
West of Study Area	Winter*	Summer	Annual	January	July
Afton	22.6 (8.9)	24.4 (9.6)	47.0 (18.5)	-10 (14.3)	20 (60.8)
Border	17.5 (6.9)	17.5 (6.9)	35.1 (13.8)	-11 (12.4)	17 (62.4)
East of Study Area					
Big Piney	6.9 (2.7)	15.0 (5.9)	21.8 (8.6)	——	——
Pinedale	11.2 (4.4)	17.3 (6.8)	28.4 (11.2)	-12 (11.5)	17 (60.2)

*Winter = October - March; Summer = April - September.

Rather than just providing an interesting setting for the study, existence of the Overthrust Belt also provides impetus to the study of this particular riparian area. Important discoveries of oil and gas associated with the thrust and fault activity have accellerated exploration projects and increased recreational demands on the area. Information applicable to management of these areas is an important aspect of the general floristic and soils study.

Superimposed on the complex geologic arrangement are Pleistocene and Recent alluvial deposits. In four of the specified drainages this alluvium dominates the geology of most of the drainage. In addition to the major alluvial deposits, most all riparian zones have been reworked to some degree by stream or glacial action. The soils sampling determined that all but one soil was developed in alluvium. This exception has developed on a moraine. It is assumed, then, that the vegetation substrates are developed from a mixture of rock types. No attempt was made, therefore, to correlate vegetation types and geology.

METHODS

Fieldwork

Field survey time was divided into two elements: field reconnaissance and sampling. Because sample plots of this study were to complement or expand the ct's of the 1980 study rather than duplicate them, much time was required to locate suitable stands.

In order to test the applicability of the Grey's River classification system, the study area was carefully traversed and vegetation examined. Each of 180 stops was referenced with a number on aerial photos provided by the Forest Service. At each location the area was walked, stands identified and classified using the 1980 key. Notes on plant species, topography, water availability and other physical factors were taken at each site. A list of reconnaissance stops and brief notes are found in Appendix I. Because of the time required to survey the area before sampling could begin, search areas were limited to those accessible by vehicle. Drainages with vehicle access were well distributed north to south, in all geologic settings and at all but the highest elevation. (see Table 2 and Figure 1).

Stand Selection

Goal 1, testing the 1980 classification, involved both looking for riparian stands which did not fit into a defined community type and looking for stands which "keyed" to a type but did not compare well with the ct description. We include in the first category those stands which keyed to "Miscellaneous Herbaceous".

Few stands were sampled during the early reconnaissance period. When it appeared that most vegetation of the Big Piney Ranger District fit easily into the Grey's River classification system, the definition of "riparian" was expanded to include areas considered marginal in 1980.

Table 2. Drainages and Abbreviations

Initials	Creek Names	Stand Numbers	Elevational* Range (meters)
NFMB	North Fork of the Middle Beaver	66-91	2438-2390
SB	South Beaver	92-109	2524-2463
NH	North Horse	32-39, 110-112 171-180	2743 (2499)**-2377
***	South Horse		2804-2377
NC	North Cottonwood	40-65, 133-136	2615-2408
SC	South Cottonwood	113-131	2646 (2585)-2463
***	North Piney		2804-2438
MP	Middle Piney	1-19	2694-2463
IC	Indian Creek	20-31	2603-2463
SP	South Piney	137-170	2621 (2499)-2377

*Includes only the reach of the creek designated for study.

**Upper elevation at which reconnaissance stopped.

***No vehicle access; not sampled.

Unlike the 1979 and 1980 studies, stands in 1981 were not chosed to "sample the variation" but to specifically characterize what appeared to be a different community type. An attempt was made to sample at least 5 plots of each potential community type. This was not achieved in all herbaceous types. Some types occurred infrequently, others generally occurred in stands too small to sample. These communities are described as "Miscellaneous Herbaceous".

A few stands which appeared intermediate between two distinct types were sampled to aid in the interpretation of soil relationships and succession. For example, _Artemisia cana_ communities, _Potentilla fruticosa_ communities and _Artemisia_ plus _Potentilla_ stands were sampled. The latter were eventually included in the _Artemisia_ ct based on soils and understory.

In all, 45 stands were sampled. Thirty-one were categorized into four new ct's, 12 included in 1980 ct units and 2 classified as Miscellaneous Herbaceous (Appendix V).

Sample Plots

In order to easily compare data, the 1980 sampling procedure was used in 1981. Described in detail in Norton et al. (1981), I will briefly summarize here.

Each sample plot, a 5 x 10 m rectangle was established in a homogeneous stand at least twice the size of the plot. At least one corner was

"permanently" staked. Blue flagging and the stake itself were marked with plot number. Sample plots are noted on the aerial photos with parentheses i.e. (164). Reconnaissance stops and plots numbered consecutively on photos and data sheets, were preceeded by initials of the Creek name. Table 2 lists the initials corresponding to creek names and indicates what range of numbers is located on each creek.

Figures 2a and 2b, the vegetation field forms used in 1981, indicate the data collected at each plot. Data collected are essentially the same as the 1980 study with omission of downed woody and duff estimates. Plant species which could not be positively identified in the field were collected and verified at the USFS Ogden Herbarium (Mont E. Lewis), Garrett Herbarium (Lois Arnow) or BYU Herbarium (Ron Kass). Voucher specimens were deposited at all three herbaria. Nomenclature follows Dorn (1977) with the exception of *Potentilla fruticosa* (*Pentaphylloides floribunda*). *Artemisia cana* ssp. *viscidula* is cited as *A. cana* for the sake of brevity. A list of species encountered in sample plots is found in Appendix II.

Productivity of herbs and shrubs was estimated on at least 3 plots of each new community type during late August. Procedures followed those of the 1980 study (Norton et al., 1981). Estimates include a correction for grazing since herbivore exclosures were not used.

Most vegetation sampling was complete before soils analysis began. A joint sampling program would have been best for interpreting vegetation

Figure 2a.

Site #: ______________

Date: ______________

Reference info:

Elev ________ ft/ ________ m   Slope ____________ %   Aspect ____________

VB type: U   V   \/   __/   ____/   width:

Position in bottom:

Microtopography:

Disturbance:

Surrounding communities:

Water depth: motion:

General appearance:

Figure 2b.

SPECIES LIST

Site # ____________________

Observer ____________________ Date ____________________

SHRUBS	cover	ht (dm)

FORBS	cover	ht (dm)

TREES	o/r	cover	ht
1			
2			
3			
4			
5			
6			
7			

FORBS continued	cover	ht (dm)
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		

GRAMINOIDS	cover	ht(dm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

patterns and soil genesis but the "complimentary" nature of the project precluded this. Because of the time involved in plot selection, it was not economically feasible to have vegetation and soil scientists working together.

Soils

Soil classification was done in late August. Observations of soils were made in pits or pit-auger hole combinations, usually to a depth of one meter. The single pedon examined within each plot was chosen to represent the typical concept of the habitat in question.

A standard pedon description was made at each site according to the guidelines established by the Soil Conservation Service (Soil Survey Staff, 1975). Sufficient data were collected to classify the soil and to develop management interpretations (see Figure 3 for data form). Supplemental information was recorded if considered useful in developing an understanding of the soil genesis or soil-plant community relationships, or if relevant to possible management considerations.

Soils were classified to the family level using Soil Taxonomy (Soil Survey Staff, 1975). Management interpretations were made using standard methods developed by the USDA, Soil Conservation Service. A summary of classifications and interpretations is found in Appendix III and IV.

Sample No.

izon	Depth	Boundary	Color Dry	Color Wet	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH	Lime	Roots	Pores

Remarks:

Figure 3

Data Analysis

Plots with similar overstory were grouped first. A matrix of plots versus species was then developed. For subsequent analysis, only species found in at least two plots of a given cover type (17-67% constancy) were considered. Species/plot matrices and an average cover and constancy table are presented in Appendices V and VI.

Computer analysis of data was not utilized for several reasons, including: limited amount of data to analyze (45 plots), subjectivity of stand choice and limited available funds. Whenever possible, field data from 1980 were used to help establish ct categories for 1981 plots.

In this study, soils, especially those in the Boroll suborder did not seem to be well correlated with vegetation differences when classified at the family level. It is suspected that criteria used in Soil Taxonomy may not be sensitive to the soil properties which most influence the native vegetation communities.

Although soil wetness (or soil moisture status) influences native plant communities of these riparian areas, the lower categories of the Boroll classification are not particularly responsive to fine differences in soil moisture status. In an attempt to ascertain soil moisture-plant community relations, Mollisolls described in this study were divided into four groups based on major differences in soil moisture observed

during the 9 day period of sampling (Table 3). Under the major groups II-IV, categories are listed in order of decreasing soil wetness as estimated by soil features. With each category in groups II and III soils are generally ranked in order of increasing depth to wet (group II) or moist (group III) soil as observed during the 9 day field study.

Since the soils were observed late in the summer it is assumed that those that are listed as having the highest moisture status also stay moist the longest. Soils of lower moisture status probably briefly attain high water contents, especially early in the summer, but such conditions do not persist, primarily because of good drainage. It is emphasized that Table 3 is a relative ranking based on only one period during one year. It is used only to indicate general trends.

TABLE 3

RELATIVE MOISTURE STATUS OF MOLLISOLS

DEPTH TO MOISTURE (DEEP ↑ … ↓ SHALLOW)

						SAWO/ POPR		
						POFR/ DECE		
						ARCA/ FEID		
ARCA/* FEID						JUBA	ARCA/ FEID	
JUBA						ARCA/* FEID	ARCA/ FEID	
CARO	SABO/ POPR			POFR/ DECE		SAWO/ POPR	ARCA/ FEID	
POPR	ARCA/* FEID		POFR/ DECE	CASI		ARCA/ FEID	ARCA/ FEID	ARCA/* FEID
JUBA	SAWO/ POPR		POFR/ DECE	MISC. HERB		JUBA	JUBA	ARCA/ FEID
MISC/ HERB	CASI	CARO	SAWO/ POPR	POFR/ DECE	POFR/ DECE	JUBA	ARCA/* FEID	ARCA/* FEID
I	II A	II B	II C	II D	III A	III B	IV A	IV B

WET ← AMOUNT OF MOISTURE → DRY

RELATIVE MOISTURE STATUS OF MOLLISOLS

DEEP ← DEPTH TO MOISTURE → SHALLOW

						SC-128		
						NFMB-89		
						SP-138		
SP-141						SP-164	NC-44	
SP-166						SC-129	SP-145	
NFMB-73	IC-28			SP-155b		SC-121	NC-44a	
SP-140	NC-133		SP-165	NH-176		SP-124	SC-119	NC-136
NFMB-77	SP-142		SP-155a	NFMB-82		NFMB-70	NFMB-88	NC-43a
MP-12	SP-149	IC-27	NC-135	SP-154	SP-159	SP-163	SC-127	NC-134
I	II A	II B	II C	II D	III A	III B	IV A	IV B

WET ← AMOUNT OF MOISTURE → DRY

TABLE 3a

Legend to Table 3a - d

Relative Moisture Status of Mollisols

I. Water table within 50-100 cm

II. Subsoil wet within 85 cm

- A. Matrix gleyed and/or O horizon
- B. Matrix gleyed, wet-very moist subsoil
- C. Common gley mottles
- D. Common gley mottles, very moist-wet subsoil, and/or O horizon

III. Subsoil moist

- A. Gleying, moist-very moist subsoil
- B. Mottles

IV. Subsoil dry-slightly moist

- A. Subsoil non-calcareous, pH below 7
- B. Subsoil calcareous, pH above 8

The relatively wettest soils are in the lower left corner of the figure. Soils are drier to the right and vertically. Neither the vertical nor horizontal axis is drawn to any scale.

The asterisk (*) indicates ARCA/FEID stands with *Potentilla fruticosa*

VEGETATION COMMUNITY TYPES

Table 4. lists Greys River and Big Piney District community types placed in the Wetland Classification of the United States (Table modified from Norton et al., 1981). After this listing is a key to community types. The key includes all types described in 1980 and in this report. The 1980 key was amended only as required to accomodate new 1981 ct's.

The discussions which follow provide both general descriptions of the cts which are being added to the 1980 riparian classification system and summaries of new field data on 1980 and 1981 types. Much of the information presented is derived from the 45 study plots sampled for vegetation and soils. Additional data are gleaned from field notes on the other 135+ sites observed during reconnaissance.

Vegetation and Physiognomy

This section identifies important floristic components of the ct, their abundance and height. Variation among plots and between 1980 and 1981 data are briefly discussed. Fidelity of species to a particular type is also mentioned when appropriate.

Habitat Features

Both macro-and micro-habitat characteristics are summarized. Position within the riparian zone is usually described.

Surrounding Communities

Adjacent communities and the type of transition to them is described for each ct. The relative topographic position of these neighbors is noted

in many cases.

Soils

In this section the taxonomy of described soils is stated along with specific soil characteristics which appear to be indicative of the ct. Special emphasis is given to soil moisture characteristics.

This report does not paraphrase general description of the soil taxonomic units. Descriptions and keys to Orders, Suborders, Great Groups, Subgroups and Families are found in *Soil Taxonomy* (Soil Survey Staff, 1975). Jensen also provides summary descriptions of the important riparian soils in the 1980 report (Norton et al., 1981). A particular soil unit is generally described only if it is important to an understanding of the ct. For example, Histosols and related soils are discussed in the *Carex simulata* ct section.

Productivity

Estimates of production are provided for each new ct and for several types proposed in 1980. It should be remembered that these figures illustrate only one growth year and are not necessarily representative of the ct.

Disturbance and Management

Disturbances varied drastically between ct's and within a ct when compared between drainages. Cattle was the principle disturbance observed. Several seismic crews were working the area (particularly North and South

Cottonwood Creeks). Besides an abundance of temporary flagging, they left little evidence of their presence in the riparian zone. Hunting and fishing camps were heavily used but generally avoided the herbaceous and shrubby riparian areas.

General management recommendations are based primarily on the ability of the soils to withstand use.

Table 4. Greys River and Big Piney District riparian classification placed in the Wetlands Classification of the U.S.

Palustrine System

I. Forested Wetland Class
   A. Needle-Leaved Evergreen Subclass
      1. *Picea* group or dominance type (dt)
         a. *Picea/Equisetum arvense* community type (ct)
         b. *Picea/Galium triflorum* ct

II. Scrub-Shrub Wetland Class
   A. Broad-Leaved Deciduous Subclass
      1. *Cornus stolonifera* group or dt.
         a. *Cornus stolonifera/Galium triflorum* ct

      2. *Salix exigua* group or dt
         a. *Salix exigua/Poa pratensis* ct

      3. *Salix boothii* group or dt
         a. *Salix boothii/Carex rostrata* ct
         b. *Salix boothii/Mitella pentandra* ct
         c. *Salix boothii/Mertensia ciliata* ct
         d. *Salix boothii/Poa pratensis* ct

      4. *Salix wolfii* group or dt
         a. *Salix wolfii/Swertia perennis* ct
         b. *Salix wolfii/Carex rostrata* ct
         c. *Salix wolfii/Poa pratensis* ct

      5. *Artemisia cana* group or dt
         a. *Artemisia cana/Festuca idahoensis* ct

      6. *Potentilla fruticosa* group or dt
         a. *Potentilla fruticosa/Deschampsia cespitosa* ct

III. Herbaceous Wetland Class (proposed)
   A. No Subclass (all are persistent)
      1. a. *Carex rostrata* ct
         b. *Poa pratensis* ct - *Poa pratensis* not always dominant
         c. *Mertensia ciliata* ct
         d. *Carex simulata* ct
         e. *Juncus balticus* ct

KEY TO OVERSTORY GROUPS

1a. Site without obvious heavy disturbance, except for flooding or nearby beaverponding.

2a. *Cornus stolonifera* more than 25 percent coverage; all *Salix* spp. less than 5 percent coverage each.
CORNUS STOLONIFERA GROUP
CRONUS STOLONIFERA/GALIUM TRIFLORUM ct

2b. *Cornus stolonifera* less than 25 percent coverage; or some *Salix* spp. more than 5 percent coverage each.

3a. *Picea* and *Abies lasiocarpa* overstory more than 5 percent (usually more than 30 percent) coverage together; all *Salix* spp. less than 5 percent coverage each. (Miscellaneous *Populus angustifolia* stands mentioned here also). *PICEA* GROUP (item D)

3b. Not as above.

✓ 4a. One or more *Salix* spp. more than 5 percent coverage each; no other shrub dominant. *Pinus contorta* overstory sometimes present, rarely to 75 percent coverage. Unit I

✓ 4b. Not as above.

✓ 5a. *Artemisia cana* more than 5 percent coverage.
ARTEMISIA CANA GROUP
ARTEMISIA CANA/FESTUCA IDAHOENSIS ct.

✓ 5b. Not as above.

✓ 6a. *Potentilla fruticosa* more than 5 percent coverage; no other shrub dominant or codominant.
POTENTILLA FRUTICOSA GROUP
POTENTILLA FRUTICOSA/DESCHAMPSIA CESPITOSA ct

✓ 6b. Trees, even tree regeneration, absent; total shrub coverage less than 5 percent
HERBACEOUS GROUP (item A)

1b. Site with obvious heavy disturbance from other than flooding or nearby beaverpond inundation. Disturbance Types

✓ Additions or changes in 1980 classification.

Unit I

1a. *Salix exigua* more than 5 percent coverage; or *Salix boothii* and *Salix drummondiana* more than 5 percent coverage, alone or together.

2a. *Salix exigua* more than 5 percent coverage.
SALIX EXIGUA GROUP
SALIX EXIGUA/POA PRATENSIS ct

2b. *Salix boothii* and *Salix drummondiana* more than 5 percent coverage, alone or together. *SALIX BOOTHII* GROUP (item C)

1b. *Salix wolfii* more than 5 percent coverage; if *Salix boothii* more than 5 percent coverage, then *Salix wolfii* dominant.
SALIX WOLFII GROUP (item B)

A. Key to Herbaceous Community Types

1a. *Carex rostrata* and *Carex aquatilis* more than 75 percent coverage, alone or together.
CAREX ROSTRATA ct

1b. *Carex rostrata* and *Carex aquatilis* less than 75 percent coverage together.

2a. *Carex simulata* more than 30 percent coverage, other *Carex* may be abundant. *CAREX SIMULATA* ct

2b. Not as above.

3a. *Mitella pentandra, Parnassia fimbriata, Saxifraga odontoloma,* and/or *Mimulus guttatus* dominant (no coverage data available). A miscellaneous HERBACEOUS type

3b. Not as above.

4a. *Mertensia ciliata* more than 25 percent coverage.
MERTENSIA CILIATA ct

4b. Not as above.

5a. *Juncus balticus* more than 30 percent coverage.
JUNCUS BALTICUS ct

5b. *Juncus balticus* less than 30 percent coverage; *Poa pratensis, Carex microptera,* and/or *Achillea millefolium* present.

5a. Coarse-soil sites with gravel on or close to surface; near streamsides.
a miscellaneous HERBACEOUS type

5b. Soil not as above; widespread.
POA PRATENSIS ct

B. Key to *Salix wolfii* Community Types

1a. *Carex rostrata* and *Carex aquatilis* more than 10 percent coverage, alone or together.

2a. *Swertia perennis, Gentianella dentosa,* and/or *Carex nebrascensis* present; ground surface mossy.
SALIX WOLFII/SWERTIA PERENNIS ct

2b. *Swertia perennis, Gentinella detonsa,* and *Carex nebrascensis* absent; ground surface seldom mossy.
SALIX WOLFII/CAREX ROSTRATA ct

1b. *Carex rostrata* and *Carex aquatilis* less than 10 percent coverage together.

3a. *Swertia perennis, Gentianella detonsa,* and/or *Carex nebrascensis* present; ground surface mossy.
SALIX WOLFII/SWERTIA PERENNIS ct

3b. *Swertia perennis, Gentianella detonsa,* and *Carex nebrascensis* absent; ground surface seldom mossy.

4a. *Mitella pentandra, Parnassia fimbriata,* and/or *Saxifraga odontoloma* dominate the herbaceous layer (no coverage data available).
a miscellaneous *SALIX WOLFII* type

4b. Not as above.

5a. *Mertensia ciliata* domanates the herbaceous layer (no coverage data available).
a miscellaneous *SALIX WOLFII* type

5b. *Mertensia ciliata* rarely present, never more than 5 percent coverage; *Poa pratensis, Helenium hoopesii,* and/or *Achillea millefolium* present.
SALIX WOLFII/POA PRATENSIS ct

C. Key to *Salix boothii* Community Types

1a. *Carex rostrata* and *Carex aquatilis* more than 25 percent coverage, alone or together.
SALIX BOOTHII/CAREX ROSTRATA ct

1b. *Carex rostrata* and *Carex aquatilis* less than 25 percent coverage together.

2a. *Mitella pentandra, Parnassia fimbriata,* and *Galium triflorum* more than t percent coverage together.
SALIX BOOTHII/MITELLA PENTANDRA ct

2b. Not as above.

3a. *Mertensia ciliata, Descurainea richardsonii,* and/or *Smilacina stellata* present.

4a. Shrubs shorter than 15 dm; coarse-soil sites with gravel to surface; near streamsides.
SALIX BOOTHII/POA PRATENSIS ct-coarse subtype

4b. Shrubs taller than 15 dm; soil not as above; widespread.
SALIX BOOTHII/POA PRATENSIS ct-modal subtype

D. Key to *Picea* Community Types

1a. *Equisetum arvense* more than 25 percent coverage.
PICEA/EQUISETUM ARVENSE ct

1b. *Equisetum arvense* less than 25 percent coverage.

2a. *Mitella pentandra, Parnassia fimbriata, Saxifraga odontoloma,* and/or *Senecio triangularis* dominate the herbaceous layer (no coverage data available).
a miscellaneous *PICEA* type

2b. Not as above.

3a. Conifers dominant; *Galium triflorum, Actaea rubra,* and/or *Smilacina stellata* present in a diverse understory.
PICEA/GALIUM TRIFLORUM ct

3b. *Populus angustifolia* dominant; understory vegetation does not key elsewhere in this system.
miscellaneous *POPULUS ANGUSTIFOLIA* communities

Artemisia cana/Festuca idahoensis (ARCA/FEID)

This is a major community type distributed throughout the study area. Twelve plots were sampled from 2472 to 2551 m (8110-8370 ft.) and recorded almost to the lower Forest boundary on North Horse Creek (2393 m, 7850 ft.).

Vegetation and Physiognomy

This ct is characterized by more than 5% coverage of *Artemisia cana*. Actual coverage in sample plots ranged from 15% to 45% and averaged 30%. Stands with and without other significant shrub components were found. *Potentilla fruticosa* is frequently present with *A. cana*. Several of these stands were sampled to compare the vegetation and soils of the "pure" and combination plots. All were eventually put in the ARCA/FEID category including one plot (NC-136) in which *P. fruticosa* cover exceeded that of *A. cana*. The only notable floristic difference between the "pure" *A. cana* and combination shrub plots is the presence of *Juncus balticus* in the mixed shrub group.

In contrast to the POFR/DECE ct., forbs dominate the understory of ARCA/FEID stands. Species with high constancy include *Helenium hoopsii*, *Achillea millefolium* and *Frageria virginiana*. *Geum triflorum* is in a majority (54%) of ARCA/FEID plots and found in only one plot without *Artemisia cana* (IC-12). *Helenium hoopsii* with greater than 5%

coverage is indicative of the dry understory with coverage in sample plots averaging 25%. Graminoids of high constancy include Agropyron caninum and Festuca idahoensis. The latter with constancy of 92% and average cover of 21% was chosen to represent the understory. Although Helenium has slightly higher constancy and coverage, it is inedible and often increases in grazed areas. The Artemisia community in more pristine conditions would probably have more Festuca and less Helenium. Artemisia cana averages about 5 dm tall generally equaling or surpassing in height all other community members. Total vegetation cover within the community varies. Some stands include areas of bare ground, ant hills and animal burrows. Forb height is usually 2-3 dm with occasional flowering heads topping 5 dm. Total graminoid cover ranged from 11 to 87%; heights averaged 4 dm with seed heads reaching 6 dm. The average height of Potentilla fruticosa is comparable to its height in POFR/DECE stands, 4-5 dm.

ARCA/FEID stands generally appeared more sparse (and drier) than other shrubby communities although dry weight production estimates do not substantiate this observation. This aspect may simply be the result of late season sampling in communities which had begun to dry out earlier than other ct's.

Habitat Features

Stands were sampled in valley bottoms 200 to over 300 m wide, 100 m and less than 50 m wide. Two plots were established outside the valley bottom: one on a terrace about 5 m above the creek and another near

Soda Lake. The location of stands within the valley bottom varied from near the creek to slopes abutting *Artemisia tridentata* or forest land. In each case the stand was positioned above the surroundings (i.e. on a terrace or levee) or on sloping ground. About half the plots were hummocked with shrubs generally inhabiting the mounds. The other plots were hilly or undulating with no specific distribution of shrubs vs. herbs.

Surrounding Communities

ARCA/FEID stands which include *Potentilla fruticosa* are usually adjacent to SAWO/POPR. Strictly *A. cana* stands are commonly adjacent to SABO/POPR, *A. tridentata* or the forest edge. SAWO/POPR was also found near "pure" *A. cana* but not frequently.

Soils

Soils of all ARCA/FEID stands were classified within four subgroups of the Cryoborolls. Mineralogy is mixed for all and textures are either fine-loamy or loamy-skeletal in the control section.

Ten out of twelve of the soils are in the dry range of Mollisols sampled (Table 3 and 3b). Their subsoils range from moist (indicated by mottles) to dry and calcareous. Two soils (SP-141 and NC-133) were wet within 65 cm of the surface (Table 3a). The water table of SP-141 was reached at 90 cm; the stand approaches within 10 m of South Piney Creek. This

RELATIVE MOISTURE STATUS OF MOLLISOLS

DEEP

↑

DEPTH TO MOISTURE

↓

SHALLOW

						ARCA/ FEID		
ARCA/* FEID							ARCA/ FEID	
						ARCA/* FEID	ARCA/ FEID	
							ARCA/ FEID	
	ARCA/* FEID					ARCA/ FEID	ARCA/ FEID	ARCA/* FEID
								ARCA/ FEID
							ARCA/* FEID	ARCA/* FEID
I	II A	II B	II C	II D	III A	III B	IV A	IV B

WET ← AMOUNT OF MOISTURE → DRY

TABLE 3b

soil is contrasted with NC-44a, also situated very close to a creek but only very slightly moist throughout the profile. Shallow (50 cm) alluvial gravels in the creek bank may keep this levee soil dry. Plot NC-133 is probably effected by localized water. The plot is topographically above and further away from the creek than NC-134, one of the driest soils.

Production

Productivity of stands seemed to vary more in this community type than in others. Production (gm/m^2) was estimated from nine samples:

Graminoids	average 33.5;range 3.1-71.4
Forbs	average 90.2; range 23.8-139.5
Total Herbaceous	average 123.7; range 82.6-206.6
Shrubs	average 45.6; range 32.4-66.4
Total	average 169.3; range 79.2-273.0

ARCA/FEID plots with *Potentilla* averaged about 1.7 times the production of stands without *Potentilla*.

Disturbance and Management

Disturbance at sites varied but was generally minor. Burrowing and ant hills were most prevalent. Some trampling and grazing was also evident. The composition of ARCA/FEID stands is probably more sensitive to grazing pressure than many of the wetter ct's. This is illustrated by an abundance of *Helenium hoopsii*.

Of all ct's identified in this study, ARCA/FEID is likely to withstand the most traffic. Roads might even be established through this ct.

Potentilla fruticosa/Deschampsia cespitosa (POFR/DECE)

Based on abundance in the drainages studied, POFR/DECE is a minor ct. Stands appear to be more abundant and can be larger than some of the wetter minor types (e.g., SABO/MIPE or CASI) but its abundance is not comparable to the major _Salix_ communities. Communities including _Potentilla fruticosa_ and other shrubs (_Artemisia_ or _Salix_) are common. These "transition" communities were usually categorized in either a _Salix_ or _Artemisia_ group (see below).

Vegetation and Physiognomy

In the POFR/DECE ct, _Potentilla fruticosa_ has greater than 5% coverage. Plots averaged 29% coverage with height of _Potentilla_ ranging from 2 to 6 dm, and averaging about 4-5 dm. Other shrub species including _Salix wolfii_, _S. boothii_ and _Artemisia cana_ are usually present but never dominant and seldom codominant. Two plots (NC-136, SP-141) with _P. fruticosa_ dominant of codominant were included in the ARCA/FEID ct based on other vegetation and soils characteristics.

Graminoids dominate the understory with two to several in each plot having greater than 5% coverage. _Deschampsia cespitosa_ typifies this graminoid dominance varying from a trace to 50% and averaging 31%.

Other species of high constancy include Agropyron caninum, Poa pratensis, Juncus balticus, Achillea millefolium, Frageria virginiana, and Potentilla gracilis. Helenium hoopsii was present in most plots but poorly represented. When present with a shrub overstory, Juncus balticus of 1% or greater cover has high fidelity to stands with P. fruticosa. These include both the POFR/DECE ct and ARCA/FEID stands containing Potentilla.

The ground surface, both between shrubs and beneath the open-growth Potentilla, is generally covered in each stand.

Habitat Features

The POPR/DECE ct was sampled in valley bottoms from 200-400 m wide. The type is found throughout the study area (most northern to most southern drainage). Many of the stands in narrower valley bottoms, e.g. North Fork Middle Beaver, were narrow bands along the valley edge, too small to sample. POFR/DECE stands sampled are generally over 50 m from the main channel. The exception is plot 89 on the North Fork of the Middle Beaver, a creek channel which is nearly dry in the section being studied.

Stands are generally flat with up to 4% slope in one plot. Microtopography varies from planar to hummocked (built up around shrubs) to gullied between shrubs. Two out of six plots had a thin moss layer on

the ground surface. None had the resilient quality of the SAWO/SWPE (1980) or CASI (1981) ct's.

Surrounding Communities

Surrounding communities include ARCA/FEID, SAWO/POPR, SAWO/SWPE and POPR. Boundaries to these ct's are gradual as Potentilla and Salix density changes. Stands classified to the SAWO group included P. fruticosa both in 1980 and 1981. The DECE and POPR understories are generally similar but neither the 1980 or 1981 SAWO/POPR areas seem to contain the abundance of Deschampsia cespitosa found under P. fruticosa. Only 15% of the 1980 SAWO/POPR type had over 5% of D. cespitosa. The species is, however, much more abundant in the herbaceous POPR ct.

SABO/POPR is also found adjacent to POFR/DECE but boundaries are more abrupt. A. cana communities are usually topographically higher than POFR/DECE but Salix stands were either higher or lower and their distribution seemed to be influenced more by local water sources (seeps and side drainages) than by the main channel. Where these supplemental water sources are not a factor, Potentilla communities often flank Salix stands and are in turn replaced by Artemisia cana with distance from the creek.

Soils

All POFR/DECE stands were classified in four subgroups of the Cryoborolls- Typic, Aquic, Calcic and Cumulic. Mineralogy is mixed and texture is fine-loamy, clayey-skeletal or loamy-skeletal in the control section.

In the relative soil moisture ranking of Mollisols (Table 3c), POFR/DECE soils varied quite a bit but are clustered in the middle of the ranking. Wetness ranges from only moist at 92 cm (NFMB-89) to wet at 56 cm (SP-155a). The soils of this ct were generally wetter than ARCA/FEID soils but not as moist as many of the *Salix* and herbaceous ct's.

Productivity

Although stands lack the luxuriant undergrowth of Carex swards, 100% of the ground surface is generally covered with vegetation. Only a few bare patches were evident. Porduction (gm/m^2) is based on three samples:

Graminoids	average 89.2; range 62.4-139.7
Forbs	average 44.4; range 20.1-64.2
Total Herbaceous	average 133.7; range 85.7-188.7
Shrubs	average 27.0; range 19.7-32.6
Total	average 160.7; range 114.5-221.3

RELATIVE MOISTURE STATUS OF MOLLISOLS

DEPTH TO MOISTURE (DEEP ↑ top, SHALLOW ↓ bottom)

I	II A	II B	II C	II D	III A	III B	IV A	IV B
						POFR/ DECE		
				POFR/ DECE				
			POFR/ DECE					
			POFR/ DECE					
				POFR/ DECE	POFR/ DECE			

WET ← AMOUNT OF MOISTURE → DRY

TABLE 3C

Disturbance and Management

Stands did not generally appear disturbed. A few burrows were found in stands. Some trampling and grazing was evident but neither *Deschampsia* nor other stand plants were severly used in this otherwise heavily grazed drainage. *Juncus* can be an increaser and may indicate heavy grazing in the past.

Stands are not currently eroded and inherent erodibility of these soils is low. This ct can support some traffic.

Juncus balticus (JUBA)

JUBA is a minor type in the study area. All samples were made on two creeks, the most northern and most southern of the area, over an elevational range of only 30 m. It can be difficult to identify JUBA stands during a vehicle-reconnaissance but some *Juncus* dominated meadows were observed on private land below the Forest.

Vegetation and Physiognomy

The JUBA ct is characterized by over 25% of *Juncus balticus*. Actual coverage averaged over 65% in the sample plots. The stands sampled are all dense graminoid communities. Half had 30-50% coverage of one or two *Carex* spp. These included *C. douglasii*, *C. praegracilis* and *C. nebrascensis*. *Carex rostrata* may be present but not in sufficient density to qualify for the CARO ct. No *Carex* was consistently found in the JUBA ct. Species with high constancy but low coverage in the type include *Deschampsia cespitosa*, *Phleum alpinum*, *Poa pratensis*, *Aster foliaceous*, *Frageria virginiana* and *Potentilla gracilis*.

Juncus balticus averaged only 3 dm tall. Many of the plants were strictly vegetative but all flowering specimens were verified as *J. balticus*. While generally maintaining a low profile, flowering stems

of both forbs and graminoids frequently overtopped the Juncus.

Habitat Features

Juncus communities were sampled in valleys ranging from 30 to 200 m wide with only one location over 100 m. The stands were generally small surrounded by shrub communities. Of the two larger meadows sampled, SP-164 is a mosaic of herbaceous communities including CARO and POPR. Density of Juncus varies in the JUBA portion. NFMB-70 is the largest JUBA sampled, measuring less than 30 x 30 m.

Several of the JUBA ct's were adjacent to or near surface water sources either currently dry creeks, rapidly flowing streams or beaver ponds. Despite their location, all sites were within 6 vertical dm of the water surface. Micro-topography was not consistent among stands ranging from flat and level to gently sloping or hummocked.

Surrounding Communities

ARCA/FEID, often including Potentilla fruticosa, was a common adjacent community. This reflects the peripheral position of most JUBA sites. Because of the generally narrow valley bottoms sampled, most of the stands were near to the valley bottom edge. SABO/POPR was also a frequent neighbor. The transition to SABO dominance is gradual with occasional Salix interspersed in a JUBA understory. Artemisia

tridentata and SAWO/POPR are also adjacent communities.

Juncus balticus was consistently part of two other community types: POFR/DECE and ARCA/FEID. Within the latter type it is restricted to stands containing *Potentilla*. In only one shrub plot did it reach the high coverage percentage of the JUBA ct (SC-127; 30%)

Soils

The JUBA soils sampled are all Mollisols. Five are Cryoborolls (Typic, Aquic, Calcic and Cumulic) and the other is a Typic Cryaquoll. In Table 3, the chart of relative moisture status, four of six soils are relatively dry in late August, drier than most POFR/DECE soils but more moist than the ARCA/FEID soils. Mottles and hemic material indicate moisture for at least part of the season.

The other two JUBA soils are among the wettest of all sampled. One is adjacent to *Salix wolfii* habitat which is being inundated by new beaver activity. The other is adjacent to a beaver pond which was filling following late August rains after being nearly dry earlier in the month. The observed moisture content of these two soils is probably wetter than in recent years and wetter than required by the *Juncus* community.

RELATIVE MOISTURE STATUS OF MOLLISOLS

DEEP ↑ — DEPTH TO MOISTURE — ↓ SHALLOW

						JUBA		
JUBA								
JUBA						JUBA	JUBA	
						JUBA		
I	II A	II B	II C	II D	III A	III B	IVA	IVB

WET ← AMOUNT OF MOISTURE → DRY

TABLE 3d

Comparisons of soil moisture status between ct's of 1980 and 1981 must be viewed with skepticism but should be mentioned. The JUBA ct appears to be generally drier than all the 1980 herbaceous types. POPR, the driest 1980 herbaceous type averaged 66 cm to the water table and 33 cm to its capillary fringe.

Salinity, common to Juncus balticus habitat was not evident at any of the sites (Holmgren and Andersen, 1976 and Arnow et al., 1980). No particular soil characteristic was found to be correlated with the JUBA ct.

Productivity

The JUBA ct is a dense, productive sward of Juncus and Carex. Little if any bare ground showed in the stands. Production (gm/m^2) was estimated from three stands.

Graminoids	average 319.7; range 178.6-539.7
Forbs	average 35.8; range 17.5-48.4
Total Herbaceous	average 355.5; range 220.1-588.1
Shrubs	average 0.73; range 0-2.2
Total	average 356.2; range 222.3-588.1

Disturbance and Management

Cattle was the main disturbance of the JUBA ct. All plots were trampled. Several were used for bedding or travel routes. All were grazed somewhat but only SP-164 was heavily eaten. In NFMB-88 *Carex nebrascensis* was the principal plant utilized. *Juncus balticus* is considered unpalitable (Holmgren and Andersen, 1976) and may increase with grazing. The high *Juncus* cover in stands may be influenced somewhat by grazing but the JUBA ct did not appear to be strictly a disturbed herbaceous type.

The shallow slopes and low inherent erodibility of the soils should permit moderate traffic in this community. Because the stands are so small they would probably be included with other types for management purposes. The JUBA stands observed should withstand at least as much grazing and traffic as any adjacent riparian type.

Carex simulata (CASI)

This is a minor ct in the Wyoming Range. Most stands were sampled along South Piney Creek, a valley with numerous seeps and side drainages. Plot elevations range from 2370 to 2545 m. This ct is comparable to a Miscellaneous Herbaceous type observed (but not sampled) in 1980.

Vegetation and Physiognomy

The stands of this community are dense swards of *Carex simulata*. Coverage in sample plots averaged over 80%. Other important *Carex* are *C. rostrata* (up to 20% coverage), *C. aquatilis* (to 25%) and *C. nebrascensis* (to 40%). Only *C. rostrata* is consistently represented but may be a minor constituent. Other species of high constancy but low coverage are *Deschampsia cespitosa*, *Pedicularis groenlandica* and *Poa pratensis*, the latter found in trace amounts in two thirds of the stands. Short (up to 2 dm) *Salix wolfii* contributed up to 3% coverage in the graminoid dominated sample plots. *Swertia perennis* and *Gentianella detonsa* were neither important nor consistent community members.

CASI stands were generally small areas of low profile. *Carex simulata* averages 2-3 dm. Flowering stems of *Deschampsia* and *Poa* often over-topped it but in small amounts. The exception is NH-176 an exceptionally vigorous

stand. _Carex simulata_ of 5-6 dm dominates 4-5 dm _C. rostrata_. Both _Carex_ bore abundant, large inflorescenses.

Habitat Features

Most CASI stands were sampled in valley bottoms over 400 m wide. One sample was taken on Indian Creek, less than 60 m wide. Within these valleys, all samples were associated with side drainages or auxiliary creek beds rather than the main channel or ponds. Two stands on South Piney Creek are in an abandoned channel which appears to have filled with organic matter. Microrelief of stands is either rolling, hummocked or generally lumpy with slopes ranging from 0 to 3%. Forbs inhabiting the stands were usually located on small rises.

Surrounding Communities

CARO and SAWO/CARO ct's are most frequently adjacent to CASI stands (each observed three times). A similar understory dominated by _Salix wolfii_ (SAWO/SWPE) was observed twice, as was ARCA/FEID. SABO/CARO and SAWO/POPR were also found adjacent to CASI. The _Artemisia_ ct and SAWO/POPR were both topographically higher than CASI.

Soils

CASI soils vary taxonomically and in their water status of late August. Three Histosols, a Cryaquent (Entisol), a Histic Cryaquoll and an Aquic Cryoboroll (Mollisols) were identified. Important similarities not

obvious from the classifications are described below.

In addition to the Miscellaneous Herbaceous types already mentioned, a Salix wolfii dominated type of 1980 (SAWO/SWPE), has an understory comparable to CASI. Both were reported to have a characteristic mossy, resilient surface over saturated soil. The 1981 CASI stands are all mossy but resilience and water status was not consistent. Conditions ranged from IC-25, saturated at the surface to HC-176 which was no more than moist throughout the profile. Even if merely moist in August, all profiles have evidence for wet conditions during part of the year, including gleying, mottling and incomplete decomposition of organic matter.

The three Histosols classified are comparable to 1980 and 1981 soils for the similar SAWO/SWPE ct. All are placed in Terric subgroups of Fibrists and Hemists indicating that mineral soil was encountered relatively near the surface. Specifically, the Histosols seen in this study had mineral soil horizons within 40-125 cm of the surface. Soils of the other three CASI plots all have surface horizons with organic material characteristic of Histosols but these horizons are not thick enough to qualify the soils as Histosols.

In attempting to correlate soil morphology and plant communities it should be remembered that plants respond much more rapidly to changes in environmental conditions than does soil morphology. Plants may also respond to smaller changes in soil characteristics than those recognized

as sufficient for a certain taxonomic classification. Thus, plant communities and soil morphology (or taxonomy) can be expected to correlate well only in sites that have had fairly stable environmental conditions for relatively long periods of time. Of the three sites in question, plot SP-149, which is closely associated with other Histosols, appears to meet these criteria. It is also most nearly a Histosol: with an organic surface 35 cm thick, it lacks only 5 of the 40 cm of organic material required to be a Histosol.

Plot SP-158 is located on an alluvial fan eminating from the high terrace on the north side of South Piney Creek. It is adjacent to, and receives its moisture from, the fan's small distributary channel. The conditions here are presently quite moist or wet and, if stable for a long time, would probably advance the formation of Histosols. However, it is likely that the distributary channel periodically shifts its course across the surface of the alluvial fan, as is typical of such geomorphic situations. Thus, the soil of plot 158 is probably not exhibiting a morphology resulting from long term exposure to these wet conditions, whereas the plant community has already responded to the high moisture status.

Plot NH-176 is in a broad abandoned stream meander more than 100 meters from the main channel of North Horse Creek. The soil here may be developing toward a Histosol, but perhaps insufficient time has passed to allow accumulation of the requisite thickness of dead plant tissue. The environment of this site seems conducive to the genesis of a Hemist: it is likely that the water table is usually high, but fluctuates, and

the pedon examined has 9 cm of hemic material at the surface overlying another 19 cm of nearly hemic mineral soil.

The range of moisture conditions in August coupled with surface moss and soil profile signs of saturated conditions suggest that the CASI environment is saturated for at least part of the year. Slope and plot location indicate that seeps and underground flow are likely sources for each stand.

A comparison of plant vigor within the sample set indicates that the stands which can dry out may provide the more favorable environment for the community. While *Carex simulata* can out-compete other species in the saturated, largely anaerobic organic soils, it may prosper under the less extreme conditions represented at NH-176. This line of reasoning is poorly supported given the small sample size but is comparable to the argument presented in Norton et al. (1981) for the small stature of *Salix wolfii* under certain conditions.

Productivity

The CASI ct is moderately productive. Estimates (gm/m^2) are based on three samples.

Graminoids	average 166.3; range 65.0-241.3
Forbs	average 7.9; range 0.8-14.0
Total Herbaceous	average 174.2; range 79.0-242.1
Shrubs	average 10.4; range 7.2-12.0
Total	average 184.6; range 91.0-254.1

Disturbance and Management

One plot (SP-158) was severely grazed by cattle but most of the plots showed little if any disturbance. The latter were, however, in areas protected from grazing (upper portion of South Piney Creek, below the cattle camp) and NH-176 which was in its third year of rest. Even *Carex nebrascensis* was abundant in this area of North Horse Creek.

For management purposes, small CASI communities can be combined with SAWO/SWPE stands. These were in turn combined with SAWO/CARO in 1980 management recommendations.

Carex rostrata Transitions (CARO)

Three stands sampled all keyed to the CARO ct category. They were sampled and described here because they differ from the 1980 type descriptions due to a large forb community component. Samples were taken with the intention of comparing vegetation and soils of these stands to the "typical" CARO stands described in 1980.

Vegetation and Physiognomy

The stands are all dense swards of either *Carex rostrata* or *C. rostrata* plus *C. aquatilis* averaging over 90% coverage. Other graminoids including *Deschampsia cespitosa*, *Poa pratensis* and *C. microptera* are present with from 1 to over 45% coverage. Forb cover averaged over 50% dominated by either *Geum macrophyllum* (IC-27 and NFMB-73) or *Polemonium occidentale* (SC-117). Less than 5% *Salix boothii* and/or *S. wolfii* is present.

Only one CARO plot from 1980 (SDM III L3b) included such a large forb component. Over 80% (80-120%) *Carex rostrata* plus *C. aquatilis* is found with over 50% *Polemonium occidentale*. This stand and SC-117 are contrasted with IC-27 and NFMB-73 not only floristically but in their substrate and perhaps successional direction.

Habitat Features

Two of the three stands were in valley bottoms less than 50 m wide. The valley bottom of SC-117 is over 200 m wide. Although the stands are all small the two with *Geum* extended from the main stream to the valley bottom edge. Valley edges are steep slopes with *Artemisia tridentata* or SABO/POPR. SC-117 lies between abandoned but wet side channels of South Cottonwood Creek. Stands are generally flat to somewhat hummocky with their ground surface about two feet above stream level. In late August there was little water in either the North Fork of the Middle Beaver (NFMB-73) or the side channel near SC-117. Indian Creek was flowing moderately fast but with water 7-9 dm below the bankfull level.

Surrounding Communities

On similar topographic positions, SABO/CARO, SAWO/CARO and SABO/POPR were adjacent to these stands. *Artemisia tridentata* and SABO/POPR, abutted the CARO on higher ground and steep side banks. A narrow band of *Mertensia ciliata* (MECI) lay next to the soggy old channel between CARO and the forested hillside at SC-117.

Soils

The two stands with *Geum macrophyllum* are classified as Cumulic Cryoborolls, wet at about 50 cm. The water table was encountered in NFMB-73 (68 cm) but not on Indian Creek. These stands are drier than the 1980 CARO ct.

Salix wolfii/Swertia perennis (SAWO/SWPE)

The field reconnaissance period sought stands dominated by *Betula glandulosa*. *Betula* often contributed a significant coverage but was not found to dominate *Salix wolfii*. The type occurs throughout the study area both with and without *Betula*.

Vegetation and Physiognomy

In stands sampled, *Salix wolfii* and *Betula glandulosa* averaged less than 20% coverage each. As *S. wolfii* increased in density, *Betula* increased more slowly and then disappeared in very dense *Salix* stands. Both shrubs are short, averaging less than 3 dm. The understory of these stands is dominated by *Carex simulata* with *Swertia perennis* (3-5%) and *Pedicularis groenlandica* (1%). *Gentianella detonsa* is present in stand SP-146. Although found in both sample plots, *Swertia perennis* was seldom present in SAWO/SWPE stands observed during reconnaissance. *Gentianella detonsa* was more frequently encountered. Based on the presence of *G. detonsa*, the SAWO/SWPE ct appeared to be more prevalent in the Wyoming Range than in the Grey's River study area. Pooling of data on this community from this and other studies may eventually suggest a more appropriate species to characterize the understory.

Low to negligible flow in nearby creeks may be allowing these stands to dry slowly and allow the forb component to flourish in the usually "pure" *Carex* sward.

The South Cottonwood stand with *Polemonium* is an Aquic Cryofluvent with a water table at 80 cm. The similar stand from the Grey's River study area was classified a Terric Borofibrist with a water table at 8 cm. This fibric soil is most similar to SC-117 which was wet at 10 cm deep with alternating hemic and silt-loam layers to 18 cm. These soils may indicate an evolution toward another wet community type. *Polemonium occidentale* was frequently observed on creek banks (1981) and in CARO and SAWO/SWPE stands during 1980. The species was also present in POPR understories.

Disturbance and Management

Some cattle grazing was evident at NFMB-73 but the stands were generally undisturbed. A few dead willows (cause unknown) were in the Carex sward at IC-27.

While somewhat drier than the 1980 stands these transition communities can be managed as other CARO meadows. Norton et al. (1981) recommended only light traffic but indicated that overgrazing is not easily detected by species composition changes.

Gentianella detonsa was also observed in the understory of Salix boothii stands (e.g. SC-118).

Habitat Features

The habitat of this ct was very similar to that described in 1980; a mossy, resilient ground surface being the most notable feature. Both sample sites are hummocky with shrubs on the hummocks. Neither stand was near the main stream channel; both were associated with a gully having water less than 1 m from the plot ground level. The water table in each stand was encountered at 40 cm and both were saturated to the surface. These and other SAWO/SWPE stands appear to be subirrigated.

Surrounding Communities

At both sample locations the Salix wolfii plus Betula glandulosa community was adjacent to SAWO/SWPE with only Salix in its overstory. ARCA/FEID occupies a small terrace above SP-146. Other SAWO/SWPE cts in the study area are adjacent to SAWO/CARO and CASI.

Soils

Soils of both stands are classified Borofibrists. Hemic Terric and Sphagnic Terric Suborders are represented. These soils are similar to both the SAWO/SWPE soils of 1980 and the CASI soils of this study. A discussion of the latter similarity is found in the CASI type description.

Productivity

In general the SAWO/SWPE ct appeared less productive than either CARO or CASI stands. Estimates (gm/m^2) of productivity are bases on two samples.

Graminoids	average 104.9; range 97.3-112.5
Forbs	average 3.6; range 3.3-3.8
Total Herbaceous	average 108.5; range 100.6-116.3
Shrubs	average 32.9; range 26.8-39.0
Total	average 141.4; range 127.4-155.3

Disturbance and Management

Little disturbance was observed in the SAWO/SWPE community. Cattle in the area traveled through the stands but did not heavily graze them.

Generally saturated soils of these communities preclude heavy use including structures and roads. More suitable soils are usually available within a short distance.

Other Sampling Locations and Community Types

Salix wolfii/Poa pratensis (SAWO/POPR)

Four stands were sampled with a dominant Salix wolfii overstory which included Artemisia cana and/or Potentilla fruticosa. All plots had over 35% coverage of S. wolfii.

Two stands with over 5% S. wolfii were considered for inclusion in this ct but were placed instead in other shrub overstory groups. This decision was based on slight dominance of another shrub (either A. cana or P. fruticosa) and understory characteristics. Relatively low soil moisture also contributed to categorization of NC-44a as ARCA/FEID. Exclusion of these stands from the Salix wolfii group necessitated a minor alteration in the 1980 community typing key.

Understories of these stands fit the description of the very general POPR type. They did not, however, have any distinctive characteristic. Poa pratensis averaged less than 1% coverage occurring in three out of four stands.

Salix boothii/Poa pratensis (SABO/POPR)

One stand of this ct was sampled early in the field season. IC-28 fits without difficulty into the SABO/POPR classification and type description. Carex microptera is the dominant understory species with Thalictrum

fendleri, Geum macrophyllum, Smilacina stellata and Deschampsia cespitosa each contributing 5-10% coverage.

Salix wolfii/Carex rostrata (SAWO/CARO)

One sampled stand fit into the SAWO/CARO ct unit. A dense cover of Salix wolfii (90%) is accompanied by a dense graminoid understory where Carex aquatilis (65%) is codominate with C. lanuginosa (65%). Carex microptera and Deschampsia cespitosa contribute 10 and 8% cover respectively but forbs are very poorly represented.

Herbaceous Stands (POPR and Miscellaneous)

Three sites dominated by various Carex species were sampled in three separate drainages. Several other sites were located during reconnaissance but these were generally too small to sample. One each of the sampled communities is dominated by Carex praegracilis (NFMB-82), C. lanuginosa (MP-12) and C. microptera (SP-140).

All three stands key to the 1980 general POPR ct, based on the presence of Achillea, Helenium, Deschampsia and C. microptera. While SP-140 is similar in dominant vegetation (C. microptera) to POPR stands of 1980, inclusion of the other two would be broadening an already very general category. Neither dominance of C. praegracilis nor C. lanuginosa has presidence in the POPR type. They are, therefore, considered

Miscellaneous Herbaceous types.

As riparian vegetation studies continue and classification schemes develop for other areas, it is likely that the POPR ct will be divided into more meaningful units. Norton, et al. (1981) and Jensen and Tuhy (1981) working on the north slope of the Uinta Mountains of Utah have suggested such a division. A reanalysis of combined data from the Grey's River 1979-1980, the Uinta Mountains project, a 1981 study in Idaho (Tuhy and Jensen, 1982) and the few herbaceous plots from this study could be a useful beginning.

DISCUSSION

Vegetation Communities

Riparian vegetation of the Big Piney Ranger District is similar to that of the Greys River Range. Major types of both areas include SAWO/CARO, SAWO/POPR, SABO/POPR and CARO. POPR, a major herbaceous type of 1980 was not abundant on study drainages of the Wyoming Range. A few minor ct's of 1980 were also poorly represented or absent. _Cornus stolonifera/Galium triflorum_, for example, is generally found at lower elevations than those studied in 1981. SAEX/POPR was only encountered near and below the Forest Service boundary. North Horse Creek was the only medium to large size drainage studied. _Picea/Galium triflorum_, suitable for sampling, occurs in this drainage but in no others. _Picea/Equisetum arvense_ was not observed in the Wyoming Range.

It is likely that the four "new" types of this study also occur in the Greys River Range. _Potentilla_ and _Artemisia_ communities were not classified in 1980 because they were considered non-riparian. Representatives of CASI and JUBA were probably included in the Miscellaneous Herbaceous category.

Patterns

Since many of the shrub and tree species discussed in 1980 were infrequent or absent in the Big Piney District study area, only the frequently observed *Salix boothii* and *S. wolfii* will be compared to 1981 ct's.

In their discussion of community relationships, Norton et al. (1981) did not place *Salix* overstories in a moisture ranking (xerophytic to hydrophytic). Neither did 1981 field observation suggest a definite ranking. *Salix wolfii*, for example, appeared healthy and stable both in standing water and on the drier edges of the riparian zone. Both the *Artemisia cana* (ARCA/FEID) and *Potentilla fruticosa* (POFR/DECE) dominated communities added to the system can be ranked more xerophytic than *Salix* communities.

One common spatial (and moisture) relationship observed among these shrub communities is:

(1) SAWO/CARO → SAWO/POPR → POFR/DECE → ARCA/FEID; SAWO/POPR → ARCA/FEID

wet ... dry

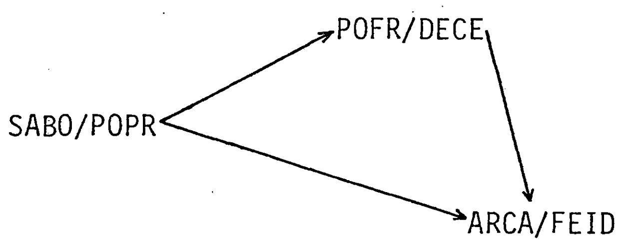
ARCA/FEID and SAWO/POPR may or may not include *Potentilla*. This series or a portion of it, often proceeds gradually to the right with distance from a water source. Drainages with a gradual transition to upland provide the most abundant habitat for *Potentilla* or *Artemisia*

cana communities (South Cottonwood). When the valley bottom is narrow with gradual side slopes (North Fork of the Middle Beaver), the transition is possible but each community is limited to a narrow strip. Wide valley bottoms with steep sides (upper North Horse Creek) may have a large *Salix* riparian community but change abruptly to forest or *Artemisia tridentata*.

Artemisia cana was not usually observed on major terraces above the valley bottom. One exceptional community is SC-119, about 5 m above the creek. This large ARCA/FEID stand, adjacent to a POPR meadow, does not, however, depend upon the creek for moisture. It is one of several small areas on the terrace slowly developing as a separate riparian zone.

Another common relationship among shrub ct's is illustrated as:

(2)

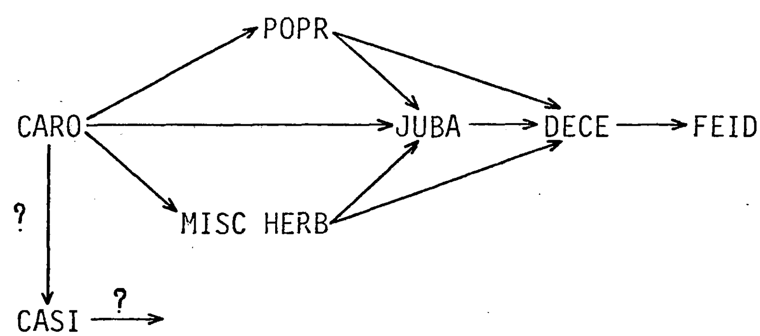


In many cases, a narrow band of SABO/POPR lined the creek or clustered around a seep or side drainage and changed to one of the drier shrub communities with very little transition.

Which way, or if, any particular stand is progressing toward a wetter or drier condition is difficult to determine in the drier shrub types. Evidence for succession from a slightly moist POFR/DECE community to a *Salix* type is developed by comparing one stand to its surroundings. Plot SP-159 occupies a moraine near the head of a small side drainage. *Salix* occupy the more developed and better watered mid and lower reaches of the gully. As the drainages deepen and collect additional water it is likely that *Salix* can invade the "ephemeral" riparian area now occupied by *Potentilla*.

A series of herbaceous and understory types organized on the basis of sampled moisture conditions appears as follows:

(3)



Considering moisture tolerance and requirements rather than observed conditions, the positions of both CASI and JUBA are elusive. Considering the range of August moisture status sampled, both JUBA and CASI communities appear able to tolerate (if not prefer) a wide range of seasonal moisture conditions. In addition, the impact of grazing on the abundance of *Juncus balticus* in JUBA and DECE communities is not

clear.

Elucidating the relationship of herb-invaded CARO communities to the typical pure Carex sward and to POPR meadows could be an interesting study in the process of succession. Neither Polemonium nor Geum may indicate a significant change from environmental conditions favorable to pure CARO. These water tolerant herbs may, however, serve to open the dense mat of vegetation to other mesophytic herbs.

Anaerobic, organic soils may be more important than consistently high moisture in favoring the Carex simulata (or Swertia perennis) herb community. Organic soils may not be required by CASI but may be tolerated in order to reduce competition from more aggressive species.

The CASI type appears to be a stable community. Data collected does not support development to any other community type except SAWO/SWPE with invasion by Salix wolfii. Stand SP-158 illustrates, however, that a change in water supply might permit aerobic conditions to reverse the development of a hemic soil.

Observations at stand SP-149a and vicinity aid in speculation on the origin or forerunner of the CASI community. The saturated community fills the outline of an old creek channel. Although many senarios are possible, one can speculate that as new channels drew water away from

the old creek bed organic matter was able to accumulate in the bed. Enough creek flow and ground water from nearby seeps kept the soil saturated and anaerobic allowing further accumulation of poorly decomposed organic matter. *Salix wolfii* and herbs common in the SWPE understory inhabit the adjacent hill and small mounds and "islands" in the channel.

Some SWPE understories with significant *Carex rostrata* and *C. aquatilis* components may develop in a similar path with a CARO meadow rather than a creek bottom as a starting point. The steeper toeslope SAWO/SWPE communities described in 1980 may require even a third point of origin.

This brief study has certainly not answered any major questions on riparian community developments. Perhaps it has provided some data to support the community classification work of others (e.g. Schlatterer, 1972) and opened a few interesting questions and possibilities.

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APPENDIX I. Reconnaissance Sites**

	Site	Community Type	Comments
	MP-1	SABO/POPR modal	dense SALX BOOT
	MP-2	MISC HERB	small seep
	MP-3	SAWO/CARO	lake inlet, CARX AQUA
	MP-4	MISC HERB	mudflat near lake
	MP-5	SABO/MECI	tight canyon
	MP-6	SABO/POPR	small site with fir & aspen
	MP-7	non-riparian herbaceous	or POPR
	MP-8	SABO/POPR coarse	streamside
	MP-9	CARO →	
		SAWO/CARO →	
		SAWO/SWPE →	GENT DETO
		SABO/POPR modal	
	MP-10	SAWO/SWPE	GENT DETO
		SAWO/CARO	across creek from SAWO/SWPE
		SABO/CARO	higher ground
	MP-11	SABO/CARO	>95% SALX BOOT & DRUM
*	MP-12	MISC HERB	CARX LANU
	MP-13	SAWO/CARO	
*	MP-14	SAWO/CARO	
	MP-15	SABO/POPR modal	75% SALX BOOT & DRUM
	MP-16	SABO/CARO	near gravel bar near creek winter killed SALX WOLF
	MP-17	SAWO/CARO	less common than MP-16
	MP-18	SAWO/SWPE	GENT DETO
		SABO/POPR	more common
	MP-19	SABO/POPR	with some Picea, Betula & Populus too small to sample
	IC-20	SAWO/CARO	
		SABO/POPR	
		POPR	small
	IC-21	SABO/CARO	braided side drainages
		SAWO/CARO	
		SABO/MIPE	
	IC-22	SAWO/SWPE	GENT DETO, CARX SIMU, MOSSY CARX SIMU & AQUA CARX SIMU, AQUA & SALX & WOLF
	IC-22a	ARCA/FEID	
	IC-23	SAWO/POPR	toeslope, SALX WOLF large
	IC-24	SAWO/CARO	across creek from toeslope
*	IC-25	CASI	
	IC-26	SAWO/CARO	SALX WOLF sprouting from twigs in beaver dam
*	IC-27	CARO	
*	IC-28	SABO/POPR	
	IC-29	CARO	large areas
	IC-30	MISC HERB	mudflat inlet to beaver dam
	IC-31	SABO/CARO	with CARX LANU, mosaic
		SABO/POPR	one large SALX BEBB near road

** Field notes available on request

NH-32	SABO/POPR	near forest edge; SALX DRUM; ARTE TRID interfingers with SALX
	SABO/CARO	closer to stream
NH-33	MISC HERB	gravel bar
NH-34	SABO/POPR	near scattered PINU CONT with 35% ARTE TRID
NH-35	SABO/POPR	with scattered PINU CONT
NH-36	SAWO/CARO	some SALX BOOT
NH-36a	SABO/POPR → CARO	abrupt change
NH-37	SAEX/POPR	gravel bar, heterogeneous
NH-38	PICEA/GATRIFL	
NH-39	MISC CONIFER	spruce, fir & pine over SALX BOOT
NC-40	MISC SAWO	mossy edge of creek
	SAWO/POPR	up slope
	SABO/MECI	hilly
NC-41	SABO/CARO	heavily grazed
NC-42	MISC SAWO	
	SAWO/POPR	
NC-43	SABO/POPR	with ARTE CANA
* NC-43a	ARCA/FEID	
* NC-44	ARCA/FEID	
* NC-44a	ARCA/FEID	
NC-45	SABO/POPR	
	SAWO/POPR	
NC-46	SAWO/POPR	large stand, SALX WOLF (7dm) closely grazed CARX
NC-47	SABO/POPR	SALX DRUM enters upstream
	SAWO/POPR	
NC-48	SABO/POPR modal	SALX DRUM; PICEA & ABIES interspersed
NC-49	SABO/POPR	SALX WOLF & PICEA
NC-50	MISC. SALIX	mixed <u>Salix</u>, saturated ground
NC-51	SABO/CARO	SALX DRUM & PICEA regeneration
	SAWO/CARO	PICEA regeneration
NC-52	SABO/POPR	steep slope, water from above
	SAWO/CARO	bottom of slope, also BETU GLAN
NC-53	SAWO/POPR	
	SABO/POPR	on steep slope to ARTE TRID; also follows old drain canals
NC-54	SAWO/POPR	
NC-55	SAWO/CARO	mostly CARX AQUA
NC-56	SAWO/CARO	valley edge
	SABO/CARO	creek side
NC-57	SAWO/SWPE	heavily grazed, GENT DETO looks more like SAWO/POPR SALX WOLF winter top kill
	SAWO/CARO	most of CARX grazed, EQUI ARVE remains
NC-58	SABO/CARO	<u>Salix</u> mixed
	SAWO/CARO	
NC-59	SABO/POPR	avenues of ARTE CANA
NC-60	POFR/DECE	small areas between SALX WOLF & BOOT
NC-61	SAWO/POPR	POTE FRUT & BETU GLAN
NC-62	POFR with CARX	small areas in SAWO/POPR
NC-63	ARCA/FEID	at edge of SALX WOLF, POTE FRUT included
NC-64	SABO/POPR	with SALX WOLF, POTE FRUT
NC-65	SABO/POPR	to forest border

NFMB-66	SABO → SAWO →	SALX BOOT & DRUM line creek,
	POFR → ARCA	narrow riparian
NFMB-67	SAWO/POPR	with POTE FRUT & ARTE CANA
	ARCA/FEID	with POTE FRUT
NFMB-68	CARO	
NFMB-69	SAWO/SWPE	CARX SIMU, mossy
*NFMB-70	MISC HERB	CARX NEBR
NFMB-71	ARCA/FEID	with POTE FRUT
NFMB-72	CARO →	
	SAWO/CARO →	SALX BOOT occasional
	SAWO/SWPE	GENT DETO
*NFMB-73	CARO	
	SAWO,SABO/CARO	SALIX both <1M POTE FRUT at edge
NFMB-74	SABO/POPR	side hill next to ARTE TRID
	SAWO/CARO	below SABO
	SAWO, SABO/POPR	with ARTE CANA
NFMB-75	CARO	with forbs, too small
NFMB-76	MISC HERB	CARX NEBR near dry beaver pond
*NFMB-77	JUBA	occasional POTE FRUT & ARTE CANA
NFMB-78	POFR/DECE	
NFMB-79	SABO/CARO, POPR	fast changing mosaic no SALX DRUM
	SAWO/CARO, POPR	
	SAWO/SWPE	GENT DETO
NFMB-80	SABO/CARO	some SALX WOLF, many forks
NFMB-81	POFR/DECE	at edge of SALX WOLF
*NFMB-82	MISC HERB	CARX PRAE, GENT DETO
NFMB-83	SABO/CARO	water in creek
	SABO/POPR	on slopes near edge
	SAWO/CARO	mosaic with SABO/CARO
	ARCA/FEID → ARTE TRID	
NFMB-84	MISC HERB	CARX NEBR
	SAWO/SWPE	GENT DETO
NFMB-85	SAWO/SWPE	CARY NEBR dom.
NFMB-86	ARTE CANA	with POTE FRUT, SALX WOLF, #82 understory
	MISC HERB	light CARX with GENT DETO, DESC/CESP, POTE GRAC, GEUM MACR
NFMB-87	SAWO/POPR	#82 understory without GENT
*NFMB-88	MISC HERB	CARX NEBR: with CARX ROST on flat; with JUNC & DESC on hill
*NFMB-89	POFR/DECE	with SALX WOLF
NFMB-90	POFR/DECE	with SALX WOLF
NFMB-91	CARO	with abundant GEUM MACR
SB-92	SABO/CARO	with SALX DRUM, saturated
	SABO/CARO	hill up to road
SB-93	SAWO/POPR	gradual hill down to SABO at stream at edge
	ARCA/FEID	
SB-94	SABO/POPR	with SALX DRUM, ARTE CANA, Symphoricarpos
SB-95	SAWO/POPR	with BETU GLAN, POTE FRUT: scattered pine, spruce & fir
SB-96	SABO/CARO	mosaic with SALX WOLF; SALX DRUM
SB-97	SABO/POPR	large (>3m) SALX DRUM; new flooding
SB-98	POPR	CARX NEBR in vicinity
SB-99	POTE FRUT & ARTE CANA/POPR	large area
SB-100	SABO/CARO	with SALX DRUM

SB-101	SABO/POPR	GENT DETO, EQUI ARVE & mesic herbs POTE FRUT: recent flooding
	CARO	pond edge
	SAWO/POPR	
SB-102	SAWO/SWPE	GENT DETO, SALIX 5dm; mossy; flooded on photo; lower than present creek
SB-102a	SABO/CARO	with SALX DRUM
SB-103	SABO/POPR	with SALX DRUM; open park-like some GENT DETO
SB-104	POFR/DECE	too small to sample; SALX WOLF
SB-105	SABO/CARO	large active beaver dam; above and below pond
	SABO/POPR	on hills.
	SAWO/CARO	on saturated soils, mosaic with SABO/CARO
SB-106	SABO/CARO	SALX mix with DRUM and WOLF
SB-107	CARO	flooded, moving water
SB-108	SAWO/SWPE	mossy, GENT ODON, SALX BOOT mixed in
SB-109	POPU TREM	POPR understory, occasional ARTE CANA & POTE FRUT
	ACRA/FEID	next to aspen, lots of POTE
NH-110	PICEA/GATRIFL	large PINUS & PICEA
NH-111	SAWO/POPR	BETU GLAN, POTE FRUT
NH-112	POFR/DECE	large area, also ARTE CANA; POTE FRUT mixed with SALX BOOT & WOLF
NH-112a	ACRA/FEID	
NH-112b	SABO/POPR	with SALX LASI
SC-113	SABO/POPR	with SALX DRUM; THAL FEND
SC-114	SABO/POPR	
	SAWO/POPR	at edge near herbaceous POPR
SC-115	CARO	heavy flowering sward along moist channel
SC-116	SABO/CARO	most SALX DRUM, soil not saturated
*SC-117	CARO	near MECI at forest edge
	SABO/CARO	across channel
SC-118	SABO/CARO	with GENT DETO
	SAWO/CARO	
	CARO	near pond
*SC-119	ARCA/FEID	
SC-120	POTE FRUT & ARTE CANA	bench above stream
*SC-121	SAWO/POPR	
SC-122	POTE FRUT	with ARTE TRID
SC-123	SAWO/CARO	more continuous than SABO
	SABO/CARO	little if any herbaceous in area
*SC-124	ARCA/FFID	near Soda Lake
SC-126	SABO/CARO →	gravel bar, SALX WOLF
	SABO/POPR	mixed in; LONI INVO on
	SAWO/CARO	steep slope 6m above water
*SC-127	ARCA/FEID	with POTE FRUT
*SC-128	SAWO/POPR	
*SC-129	ARCA/FEID	with POTE FRUT
SC-130	SABO/POPR	some CARO understory
SC-131	SABO	with SALX DRUM, SALX WOLF
*NC-133	ARCA/FEID	with POTE FRUT
*NC-134	ARCA/FEID	with POTE FRUT
*NC-135	SAWO/POPR	with ARCT UVA
*NC-136	ARCA/FEID	with POTE FRUT
SP-137	SABO/CARO	small herbaceous patches in area
*SP-138	ARCA/FEID	
SP-139	CARO	some areas mossy with PEDI but no GENT DETO

*	SP-140	POPR	
*	SP-141	ARCA/FEID	with POTE FRUT
*	SP-142	SAWO/POPR	
*	SP-145	ARCA/FFID	
*	SP-146	SAWO/POPR	lots of seeps in this stream section
*	SP-147	SAWO/SWPE	
*	SP-148	CASI	
*	SP-149	CASI	
*	SP-149a	CASI	
	SP-150	CASI	near road, small
	SP-151	POFR & ARCA	
	SP-152	CAREX MEADOW	
*	SP-154	POFR/DECE	
*	SP-155a	POFR/DECE	
*	SP-155b	POFR/DECE	
	SP-156	SAWO/POPR	
		ARCA/FEID	with POTE FRUT
	SP-157	POFR/DECE	
*	SP-158	CASI	mossy, GENT DETO
*	SP-159	POFR/DECE	
	SP-160	ARTE CANA	
	SP-161	MIXED SHRUB	POTE FRUT, ARTE CANA, SALX WOLF
	SP-162	SABO/POPR	with SALX DRUM, EXIG
		SABO/CARO	less than SABO/POPR, new beaver activity
*	SP-163	JUBA	near disturbed area
*	SP-164	JUBA	
*	SP-165	POFR/DECE	
	SP-165a	JUBA	to small to sample
*	SP-166	JUBA	
	SP-167	JUBA	small area encroached by shrubs ARTA CANA, POTE FRUT
	SP-168	JUBA	small,
		ARCA POFR	and mixed overstory
	SP-170	ARCA/FEID	with dense ARTE
		SABO-SAWO	mixed; CARO & POPR under
	NH-171	SALX DRUM	dominant on gravel bars
	NH-172	CARO →	large ponds edged in CARO
		SABO/CARO →	narrow transition
		SABO/POPR	with, SALX DRUM; few SALX WOLF in area
	NH-173	PICEA	narrow area along large beaver pond CARX AQUA & other wet graminoids
		MISC PICEA	seep on hill above, mossy with PARN FIMB, SAXI ODON; pond killing trees
		PICEA/GATRIFL	near pond
	NH-174	SABO/POPR	with PICEA, ABIES mixed above fairly wet understory; SALX DRUM
	NH-175	CARO	near large pond
	NH-176a	PICEA/GATRIFL	hill leading to stream, edged in places with CARX MICR
*	NH-176	CASI	
	NH-177	CARO →	range improvement in area;
		POPR	killed ARTE
	NH-178	SABO/POPR	relatively wet, most common, SALX DRUM is abundant
		SAEX/POPR	occasional strip, with SALX DRUM in dry creek channel

NH-179	SAWO/SWPE → CARO	mossy & CARX SIMU;
	ARCA & POFR	various mixtures of shrubs, common in lower, not upper creek
NH-180	PICEA/GATRIFL	also #178 continues here

Appendix II. Species List

BETULACEAE

Betula glandulosa

BORAGINACEAE

Hackelia floribunda
Mertensia ciliata

CAPRIFOLIACEAE

Lonicera involucrata

CARYOPHYLLACEAE

Arenaria sp.
Stellaria longipes

COMPOSITAE

Achillea millefolium
Antennaria anaphaloides
Antennaria microphylla
Arnica longifolia
Artemisia cana ssp. viscidula
Artemisia ludoviciana
Artemisia tridentata ssp. vaseyana
Aster eatonii
Aster foliaceus
Aster integrifolius
Aster sp.
Cirsium scariosum
Erigeron peregrinus
Erigeron spp.
Helenium hoopesii
Rudbeckia occidentalis
Senecio integerrimus
Senecio serra
Senecio sphaerocephalus
Senecio triangularis
Senecio sp.
Solidago multiradiata
Taraxacum officinale

CRUCIFERAE

Descurainea richardsonii
Rorippa curvipes

CYPERACEAE

Carex aquatilis
Carex aurea
Carex douglasii
Carex lanuginosa
Carex microptera
Carex nebrascensis
Carex norvegica
Carex pachystachya
Carex praegracilis
Carex raynoldsii
Carex rostrata
Carex scirpoidea
Carex simulata
Carex sp.

EQUISETACEAE

Equisetum arvense
Equisetum hyemale
Equisetum laevigatum

ERICACEAE

Arctostaphylos uva-ursi
Pyrola asarifolia
Pyrola minor

GENTIANACEAE

Frasera speciosa
Gentiana affinis
Gentianella amarella
Gentianella detonsa
Swertia perennis

GERANIACEAE

Geranium richardsonii
Geranium viscosissimum

GRAMINEAE

Agropyron caninum
Agropyron dasystachyum
Agropyron smithii
Agrostis exarata
Agrostis scabra
Alopecurus aequalis
Bromus anomalus
Bromus carinatus
Bromus ciliatus
Bromus inermis
Calamagrostis canadensis
Calamagrostis inexpansa
Dactylis glomerata
Deschampsia cespitosa
Elymus glaucus
Festuca idahoensis
Hordeum brachyantherum
Koeleria cristata
Muhlenbergia filiformis
Phleum alpinum
Phleum pratense
Poa fendleriana
Poa pratensis
Poa sandbergii
Poa trivialis
Stipa columbiana
Trisetum spicatum

GROSSULARIACEAE

Ribes sp.

HYDROPHYLLACEAE

Hydrophyllum capitatum

IRIDACEAE

Sisyrinchium angustifolium

JUNCACEAE

Juncus balticus
Juncus ensifolius
Juncus tenuis

LABIATAE

Agastache urticifolia
Mentha arvensis

LEGUMINOSAE

Astragalus sp.
Lupinus lepidus
Lupinus sp.
Trifolium longipes

LILIACEAE

Smilacina stellata
Streptopus amplexifolius
Zigadenus elegans

LINACEAE

Linum perenne

ONAGRACEAE

Epilobium angustifolium
Epilobium glandulosum
Epilobium paniculatum

ORCHIDACEAE

Habenaria hyperborea

PINACEAE

Abies lasiocarpa
Picea engelmannii
Pinus contorta

POLEMONIACEAE

Phlox sp.
Polemonium occidentale

POLYGONACEAE

Eriogonum umbellatum
Rumex sp.

RANUNCULACEAE

Actaea rubra
Caltha leptosepala
Ranunculus acriformis
Ranunculus cymbalaria
Ranunculus sp.
Thalictrum fendleri

ROSACEAE

Amelanchier alnifolia
Crataegus douglasii
Fragaria virginiana
Geum macrophyllum
Geum triflorum
Potentilla anserina
Potentilla fruticosa
Potentilla gracilis
Rosa woodsii

RUBIACEAE

Galium boreale
Galium triflorum

SALICEAE

Populus tremuloides
Salix bebbiana
Salix boothii
Salix drummondiana
Salix exigua
Salix geyeriana
Salix lasiandra
Salix lutea
Salix wolfii

SAXIFRAGACEAE

Mitella pentandra
Parnassia fimbriata
Saxifraga odontoloma

SCROPHULARIACEAE

Castilleja miniata
Castilleja sulphurea
Mimulus guttatus
Pedicularis groenlandica
Penstemon sp.
Veronica americana

UMBELLIFERAE

Angelica arguta
Angelica pinnata
Heracleum sphondylium
Lomatium sp.
Osmorhiza sp.
Zizia aptera

VALERIANACEAE

Valeriana edulis
Valeriana occidentalis

VIOLACEAE

Viola sp.

APPENDIX III. Soil Characteristics

COMMUNITY TYPE Soil Suborder Particle Size Class Plot	Elevation Meters (Feet)	Depth to Water Table or (Wet Soil) (cm)	Profile Description Horizon (Thickness (cm))/Texture(% Coarse Fragments)
ARCA/FEID			
Typic Cryoboroll			
fine-loamy			
NC-44a	2496 (8190)	> *	A11(10)/1(<5),A12(12)/cl(<5),c(78)/cl(<5)
NC-136	2493 (8180)	>	A11(15/1(<5),A12(22)/1(<5),B2(33)/cobcl(25),Cca(30)/cl(10),C2(20)/vgscl(35)
loamy-skeletal			
NC-43a	2513 (8245)	>	A1(6)/1(5),A3(16)/1(5),C(38)/1(5),IIC2(20)/exgscl(75)
NC-44	2509 (8230)	>	A1(25)/1(5),B2(29)/1(<5),C(16)/1(<5),IIC(20)/exgsl(80)
SC-119	2551 (8370)	>	A11(7)/vgl(35),A12(19)/gcl(20),IIC954)/exgl(85)
SC-129	2493 (8180)	>	A11(11)/gl(25),A12(11)/gcl(30),A3ca(15)/gcl(25),B2(15)/vstsicl(40),IIC(33)/scl(75)
Aquic Cryoboroll			
fine-loamy			
SP-141	2484 (8150)	90 (43)	A11(9)/1(5),A12g(19)/1(5),IIC1g(15)/vgcl(40),IIIC2g(35)/sicl,IVC3g(32)/vgscl(40)
Calcic Pachic Cryoboroll			
fine-loamy			
NC-133	2490 (8170)	(60)	A11(15)/1(10),A12(22)/1(5),A13(23)/cl,(5),C1ca(35)/gcl(5),C2ca(30)/gl(15),C3(15)/gl(15
loamy skeletal			
NC-134	2489 (8165)	>	A11(15)/1(5),A12(25)/1(5),IIB2(30)/vcobcl(50),IIB3(30)/vcobcl(50)
Cumulic Cryoboroll			
fine-loamy			
SP-138	2496 (8190)	>	A11(15)/sil(5),A12(30)/cl(5),C(55)/cl(10)
SP-145	2472 (8110)	>	A11(15)/1(<5),A12(37)/1(<5),AC(48)/cl(5)
SC-124	2536 (8320)	>	A11(15)/gl(25),A12(30)vgl(50),C(50)/vgcl(50)
SC-127	2524 (8280)	>	A11(18)/cl(5),A12(22)/sil(<5),IIC(17)/cosl(75),IIIAb(23)/cl(5),IVC(25)/exgsl(80)
POFR/DECE			
Typic Cryoboroll			
loamy-skeletal			
SP-154	2460 (8070)	(100)	A1(18)/1(5),C(15)/1(<5),IIA1b(22)/1(<5),IICb(45)/vgsl(65)
Aquic Cryoboroll			
loamy-skeletal			
SP-155a	2457 (8060)	(56)	A11(13)/1(5),A12(17)/cl(<5),C1(26)/cl(<5),IIC2(24)/exgrcosl(75),IIC3(20)exgrcosl(85)
Calcic Cryoboroll			
fine-loamy			
SP-165	2399 (7870	(82)	A11(6)/1,A12(14)/1,C1ca(18)/1,C2(24)/cl,C3(20)/sicl,IIC4(33)/scl
clayey-skeletal			
SP-159	2454 (8050)	>	A11(10)/1(10),A12(22)/cl(5),Cca(68)/vgcl(40)
Cumulic Cryoboroll			
fine-loamy			
NFMB-89	2402 (7880)	>	A11(10)/1,A12(35)/1,IIB2(47)/cl,IIC(8)/scl(80)
SP-155b	2451 (8040)	>	02(10)/sod,A11(13)/1(<5),B2(30)/sicl(<5),IIC1g(35)/c,IIIC2g(27)/vfscl
JUBA			
Typic Cryaquoll			
fine-loamy			
SP-166	2402 (7880)	75 (45)	A11(8)/cl,A12(18)/cl,C1g(59)/fscl,IIC2g(15)/sic
Typic Cryoboroll			
fine-loamy			
SP-163	2399 (7870)	>	A11(10)/1(<5),A12(21)/cl(<5),C1(8)/c,C2(12)/cl,IIC3(11)/sil,IIIC4(6)/1(<5)
loamy-skeletal			
NFMB-88	2405 (7890)	>	A11(8)/1,A12(15)/gcl(25),C(37)/excobcl(70)
Aquic Cryoboroll			
loamy-skeletal			
NFMB-77	2431 (7975)	60 (30)	A11(10)/1(<5),A12(20)/cl,C1(20)/cl(<5),IIC2(20)/vgscl(60)
Calcic Cryoboroll			
fine-loamy			
SP-164	2399 (7870)	(100)	A11(10)/cl,A12ca(13)/cl,B1ca(42)/cl,C(35)/fsl,IIC2(15)/exgscl(70)

* Depth to water table and wet soil is greater than depth of the soil pit.

COMMUNITY TYPE Soil Suborder Particle Size Class Plot	Elevation Meters (Feet)	Depth to Water Table or (Wet Soil) (cm)	Profile Description Horizon (Thickness (cm))/Texture (% Coarse Fragments)
Cumulic Cryoboroll			
fine			
NFMB-70	2402 (7880)	>	A11(13)/l,A12(28)/cl,C1(24)/sicl,C2(15)/cl,IIC3(+)/exgcl(70)
CASI			
Histic Cryaquoll			
loamy-skeletal			
SP-149	2469 (8100)	(35)	Oi(13)/FIB,Oe(22)/HEM,A11(15)/gsicl(25),C(20)/vgsicl(50)
Aquic Cryoboroll			
fine-loamy			
NH-176	2371 (7780)	>	Oi(9)/HEM,A1(19)/cl,C(28)/cl,IIA1(27)/cl
Typic Cryaquent			
fine			
SP-158	2438 (8000)	>	Oi(14)/FIB,Cg(16)/Sic(10),C2g(60)/cobsic(25)
Terric Sphagnofibrist			
loamy-skeletal			
IC-25	2545 (8350)	0	Oi1(12)/FIB,Oi2(28)/FIB,A(10)/sicl,C(35)/FIB
Terric Borohemist			
loamy-mixed			
SP-149a	2469 (8100)	>	Oi(40)/FIB,Oe(30)/HEM,C1g(20)/sicl,C2s(30)/sicl,C3g(20)/sicl
sandy-skeletal			
SP-148	2469 (8100)	20 (0)	Oi(45)/FIB,Oe(25)/HEM,C(15+)/exgrls(80)
CARO			
Cumulic Cryoboroll			
fine			
NFMB-73	2432 (7980)	68 (50)	A11(30)/cl,A12(20)/c,C1g(20)/c(<5),IIC2g(5)/vgcl(60)
fine-loamy			
IC-27	2527 (8290)	(52)	A11(13)/cl,A12(19)/cl,IIA1b(20)/sicl,IIIC(33)/fscl(<5)
Aquic Cryofluvent			
loamy-skeletal			
SC-117	2560 (8400)	80 (10)	O2(10)/HEM,A(10)/sil(<5),IIO2(8)/HEM,IIA(18)/cl(<5),IIIC(39)/sl(80)
POPR			
Typic Cryaquoll			
fine-loamy			
SP-140	2484 (8150)	60	A11g(9)/l(<5),A12g(26)/l(<5),IIC1g(15)/sicl(<5),IIC2g(20)/l(<5)/IIIC3(15)
MISCELLANEOUS HERBACEOUS			
Typic Cryaquoll			
loamy-skeletal			
MP-12	2527 (8290)	50 (26)	A11(11)/cl(<5),A12(15)/cl(<5),IIC(29)/exgcosl(75)
Cumulic Cryoboroll			
fine			
NFMB-82	2402 (7880)	(70)	A11(10)/l,A12(38)/cl(<5)IIC(22)/c,IIIC(30)/cl
SAWO/SWPE			
Hemic Terric Borofibrist			
loamy-skeletal			
SP-146	2469 (8100)	40 (0)	Oi(40)/FIB,Oe(50)/HEM,Oa(35)/SAP,C(15)/vgsl(45)
Sphagnic Terric Borofibrist			
loamy			
SP-147	2469 (8100)	40 (0)	Oi(45/FIB,Oe(25)/FIB,C1(15)/l,C2g(15)/scl
SAWO/CARO			
Typic Cryaquent			
loamy-skeletal			
MP-14	2527 (8290)	25 (20)	A11(10)/gsl(25)/IIA12b(10)/cl,IIC1(25)/cl(<5),IIIC2(25)/cl(60)
SAWO/POPR			
Typic Cryoboroll			
loamy-skeletal			
SC-128	2490 (8170)	>	A(28)/excobcl(65),C(16)/exstcl(80),IIC2(21)/exstscl(80)
Aquic Cryoboroll			
fine-loamy			
NC-135	2496 (8190)	(37)	A11(16)/l(5),A12(21)/cl(5),Cg(63)/stcl(25)
Cumlic Cryoboroll			
fine-loamy			
SP-142	2477 (8125)	(50)	A11(20)/l(5)/A12(30)/l(5),IICg(20)/cl(35)IIC2g(30)/cl(25)
loamy-skeletal			
SC-121	2560 (8400)	>	A11(10)/vgl(40),A12(36)/vgl(50),C(46)/exgscl(75)
SABO/POPR			
Aquic Cryoboroll			
fine-loamy			
IC-28	2527 (8290)	(80)	A11(13)/l(<5),A12(17)/sicl(<5),C1(42)/gscl(15),C2g(20)/gscl(15),IIC3(+)

Appendix IV. Soil Interpretations

	Drainage Class	Soil Permeability	Available Water-holding Capacity	Runoff (Hydrologic Soil Group)	Inherent Erodibility	Current Erosion
Typic Cryaquent						
fine	vp	vs	m	h	l	n
loamy-skeletal	vp	s	m	h	l	n
Aquic Cryofluvents						
loamy-skeletal	vp	ms	m	mh	l	n
Hemic Terric Borofibrists						
loamy-skeletal	vp	mr	h	h	l	n
Sphagnic Terric Borofibrists						
loamy	vp	m	h	h	l	n
Terric Sphagnofibrists						
loamy-skeletal	vp	s	h	h	l	n
Terric Borohemists						
loamy	vp	s	h	h	l	n
sandy-skeletal	vp	r	h	h	l	n
Typic Cryaquolls						
fine-loamy	vp	s	m	h	l	n
loamy-skeletal	vp	ms	m	h	m	n
Histic Cryaquolls						
loamy-skeletal	vp	s	h	h	l	n
Typic Cryoborolls						
fine-loamy	sp-mw	s-ms	m	mh	l	n
loamy-skeletal	sp-w	s-ms	l-m	ml	l	n

	Drainage Class	Soil Permeability	Available Water-holding Capacity	Runnoff (Hydrologic Soil Group)	Inherent Erodibility	Current Erosion
Aquic Cryoborolls						
fine-loamy	vp-sp	s-ms	m	mh	l	n
loamy-skeletal	vp-p	ms	m	mh	l	n
Calcic Cryoborolls						
fine-loamy	vp	s-ms	m	mh	l	n
clayey-skeletal	vp	s	m	mh	l	n
Calcic Pachic						
fine-loamy	sp	ms	m	mh	l	n
loamy-skeletal	w	ms	m	ml	m	n
Cumulic						
fine	p-sp	vs-s	m	mh	l	n
fine-loamy	vp-w	s-ms	m	mh	l	n
loamy-skeletal	sp-mw	ms	l	ml	l	n

Drainage Class

Drainage classes are based on characteristics of soil morphology associated with different degrees of aeration. Extent of aeration is influenced by a combination of runoff, soil permeability, and internal soil drainage characteristics. The seven drainage classes are briefly described below. Complete definitions are given in the pamphlet "Definitions and Abbreviations for Soil Descriptions" (USDA-SCS, 1979). Abbreviations are given in parentheses.

Very poorly drained (vp): The water table remains at or near the surface a greater part of the time.

Poorly drained (p): The soil remains wet much of the time with the water table seasonally near the surface for prolonged intervals.

Somewhat poorly drained (sp): Soil is wet for significant periods, but not all of the time.

Moderately well drained (mw): Profile is wet for a small but significant part of the time.

Well drained (w): Water is removed from the soil readily but not rapidly.

Somewhat excessively drained: Water is removed from these soils rapidly.

Excessively drained: Water is removed from these soils very rapidly.

Soil Permeability

Soil permeability describes the ability of soil to transmit water and air. It is used here in reference to the rate at which the soil transmits water while saturated. Formal definitions are given below.

Permeability class (abbreviation)	Water transmitted (inches/hour)
very slow (vs)	less than 0.06
slow (s)	0.06 - 0.2
moderately slow (ms)	0.2 - 0.6
moderate (m)	0.6 - 2.0
moderately rapid (mr)	2.0 - 6.0
rapid (r)	6.0 - 20.0
very rapid (vr)	more than 20.0

Ratings assigned to soils in this investigation were estimated from soil characteristics, including texture, structure, and rock fragment content, of the least permeable layer of each profile (Erickson, 1973).

Available Water-holding Capacity

Available Water-holding Capacity is the amount of water available for plant use that a soil can potentially hold. It is primarily determined by soil texture and rock fragment content. The definitions and abbreviations of three classes used here are as follows.

1. Low capacity (0.02 - 0.10 inch water/inch soil)
2. Moderate capacity (0.10 - 0.20 inch water/inch soil)
3. High capacity (0.20 - 0.28 inch water/inch soil)

Runoff Potential (Hydrologic Soil Group)

Hydrologic soil groups are used to estimate runoff from rainfall using soil properties that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. Properties considered are depth of seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. Runoff potential classes used here equate to the hydrologic soil groups defined by the USDA-SCS (Rogers, J.H., 1978).

Class (abbreviation)

1. Low (l)
2. Moderately Low (ml)
3. Moderately High (mh)
4. High (h)

Inherent Erodibility

Inherent erodibility is a measure of potential soil loss by water erosion. Soil properties considered in assigning an inherent erodibility class to a soil are texture, structure, organic matter content, and rock fragment content. Inherent erodibility as used here is based on the "K" value of the Universal Soil Loss Equation (Erickson, 1973).

Class (abbreviation)	"K" value
1. High (h)	greater than 0.40
2. Moderate (m)	0.20 to 0.40
3. Low (l)	less than 0.20

Current Erosion

Current erosion ratings describe the present status of the soil surface with respect to soil loss due to wind and/or water action. Ratings are assigned on the basis of observed loss of surface soil, gullies, blowouts, and hummocks (USDA-SCS, 1979). Brief definitions of the classes follow, abbreviations are in parentheses.

Uneroded or slightly eroded (n): Less than 25% of the surface soil (the original surface 6 inches or the A horizon, which ever is deeper) is removed.

Moderately eroded (m): 25 to 75% of surface soil removed.

Severely eroded (s): More than 75% of surface soil removed.

Very severely eroded (vs): All surface soil and 25 to 75% of subsoil removed.

APPENDIX V. SPECIES / PLOT MATRICES

	ARCA/FEID													POFR/DECE						SABO/POPR
	NC 43a	NC 44	SC 119	SC 124	SP 138	SP 145	NC 44a	NC 136	SC 127	SC 129	NC 133	NC 134	SP 141	SP 165	SP 159	SP 155a	SP 154	SP 155b	NFMB 89	IC 28
SHRUBS																				
ARTE CANA	3	3	3	3	2	4	2	2	3	3	2	2	2	1	.	1	T	.	1	.
BETU GLAN	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
POTE FRUT	.	.	.	.	.	.	.	3	2	2	2	2	2	3	4	3	2	2	2	T
SALX BOOT	.	1	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	5
SALX WOLF	.	1	.	.	.	.	2	T	1	1	1	.	.	.	.	.	.	.	2	+
GRAMINOIDS																				
CARX PRAE	.	.	.	1	.	.	.	.	.	.	1	.	.	T	.	.	4	.	1	.
CARX DOUG	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	2	.	2	.	.
CARX SCIR	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.
CARX AQUA	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CARX LANU	.	.	.	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.
CARX MICR	.	.	1	3	.	T	.	.	3	.	2	.	2	.	.	1	1	2	1	5
CARX NEBR	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CARX ROST	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CARX SIMU	.	.	.	.	.	.	.	.	.	.	.	.	.	T	T	.	.	.	.	.
CARX UNK	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
AGRO CANI	1	1	1	1	1	2	1	.	1	1	1	.	2	1	T	2	1	1	1	1
AGRS SCAB	.	.	.	1	.	1	.	.	.	.	T	.	.	.	.	.	.	.	.	.
DESC CESP	.	.	.	.	2	.	T	.	2	.	1	.	T	T	3	3	2	4	3	2
FEST IDAH	2	2	4	3	T	3	.	2	.	4	3	3	2	.	2	.	.	.	.	.
HORD BRAC	.	.	.	T	T	.	.	.	T	.	.	.	.	.	.	2	.	1	T	T
JUNC BALT	.	.	.	T	.	.	.	1	3	2	1	2	2	2	2	2	1	2	.	.
KOEH SP1	1	T	.	.	.	1	1	1	.	.	.	1	.	2	1	.	T	.	.	.
KOEH SP2	.	.	.	.	.	.	.	.	.	1	T	.	.	.	.	.	.	.	.	.
PHLE ALPI	.	.	.	T	2	T	T	.	.	.	T	.	1	.	.	.	.	.	1	T
POA PRAT	T	T	.	1	2	2	.	.	T	T	.	.	T	T	.	1	1	1	T	1
STIP COLU	1	.	.	1	.	1	.	T	.	T	1	.	.	2	.	.	.	.	.	.
TRIS SPIC	T	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FORBS																				
ACHI MILL	1	1	1	T	2	1	2	.	T	T	T	T	2	1	1	1	T	1	2	1
AREN SP	.	.	2	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ANTE MICR	1	.	1	.	.	.	.	1	1	1	T	T	.	1	2	.	.	.	.	T
ASTE EATO	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	2	.	.	.
ASTE INTE	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ASTE FOLI	2	1	.	.	.	.	2	.	.	.	T	.	2	.	2	2	.	3	1	T
CAST MINI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CIRS SCAR	.	.	1	1	.	.	.	1	T	1	T	T	.	1	T	T	T	.	T	.
CYMO SP	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
EPIL PANI	T	T	.	.	.	.	T	.	.	T	T	.	.	.	.	.	.	.	.	.
EQUI LAEV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.
FRAG VIRG	.	1	1	3	3	1	2	2	4	2	3	2	3	1	2	1	2	3	1	1
GALI BORE	.	.	.	.	.	.	.	.	.	T	T	.	.	.	.	.	.	.	.	T
GENT AMAR	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GENT AFFI	.	.	+	1	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.
GENT DETO	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	T	.	.
GEUM MACR	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	2
GEUM TRIF	.	.	1	.	.	T	.	1	1	T	T	2	.	.	.	.	.	.	.	.
HELE HOOP	1	2	2	4	3	3	3	2	4	2	3	2	2	1	.	1	1	+	2	1
LINU LEWI	T	.	.	.	.	.	1	1	.	T	.	1	.	.	.	.	.	.	.	.
LUPI LEPI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.
PEDI GROE	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	1	.	.	.
PENS SP	1	.	1	T	.	.	.	1	T	.	1	2	.	.	.	.	.	.	.	.
POLE OCCI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
POTE GRAC	.	.	T	.	2	2	T	1	1	T	T	2	2	1	.	2	T	2	2	T
SENE SP	1	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.
SMIL STEL	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2
SWER PERE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
TARX OFFI	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	T	T	.	.	.
THAL FEND	.	1	.	.	.	.	T	.	.	.	T	.	.	.	.	.	.	.	.	2
TRIF LONG	.	T	.	.	.	.	T	.	.	.	.	.	1	.	.	T	.	.	.	.
VALE EDUL	2	2	+	.	2	1	2	.	2	.	.	.	.	.	.	1	1	T	.	.
VALE OCCI	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.
VIOL SP	.	.	1	.	.	.	.	.	.	.	T	.	.	.	.	.	T	.	.	.

	SAWO/CARO	SAWO/POPR				SAWO/SWPE		CARO			MISC HERB	POPR	MISC HERB	JUBA					
	MP 14	SP 142	SC 121	SC 128	NC 135	SP 146	SP 147	SC 117	NFMB 73	IC 27	MP 12	SP 140	NFMB 82	SP 164	SP 166	SP 163	NFMB 88	NFMB 77	NFMB 70
SHRUBS																			
ARTE CANA	.	2	2	T	1	.	.	.	.	.	.	.	.	.	1	.	.	1	.
BETU GLAN	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.
POTE FRUT	.	.	.	2	3	.	.	.	.	.	+	.	.	.	.	T	.	.	.
SALX BOOT	1	.	.	.	.	.	.	1	.	T	.	.	.	.	1	T	.	.	.
SALX WOLF	5	3	3	3	3	2	2	1	.	.	.	.	.	.	.	.	T	.	.
GRAMINOIDS																			
CARX PRAE	.	.	.	.	.	.	.	.	.	.	1	.	5	1	.	1	2	.	.
CARX DOUG	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	1	.
CARX SCIR	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CARX AQUA	4	.	.	.	.	.	.	4	2	.	.	.	.	.	.	.	.	.	.
CARX LANU	4	.	.	2	2	.	.	.	.	.	6	T	.	.	.	.	.	.	.
CARX MICR	2	.	T	.	2	.	.	2	.	T	2	5	1	.	T	.	.	1	.
CARX NEBR	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
CARX ROST	.	.	.	.	.	.	.	3	5	6	.	.	.	.	.	.	.	2	.
CARX SIMU	.	.	.	.	.	6	4	.	.	.	.	T	.	.	.	.	.	.	.
CARX UNK	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
AGRO CANI	.	1	T	1	1	.	.	.	.	T	T	.	.	T	T	.	.	1	T
AGRS SCAB	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
DESC CESP	2	1	.	1	2	T	T	.	1	3	2	2	1	T	T	1	2	1	1
FEST IDAH	.	1	3	2	1	.	.	.	.	.	.	.	.	.	.	.	.	T	.
HORD BRAC	.	.	.	.	.	.	.	.	.	T	.	1	.	.	.	1	.	.	T
JUNC BALT	.	.	.	T	1	.	3	.	.	T	.	.	1	6	4	6	4	3	4
KOEH SP1	.	.	.	.	T	.	.	.	.	.	.	T	.	.	.	.	.	.	.
KOEH SP2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PHLE ALPI	.	1	T	T	.	.	.	.	.	.	.	.	1	T	T	T	1	.	T
POA PRAT	.	T	T	1	.	.	.	T	.	2	T	.	1	1	T	T	1	1	1
STIP COLU	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
TRIS SPIC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FORBS																			
ACHI MILL	T	1	1	T	.	.	.	T	T	1	T	T	2	T	T	.	.	1	1
AREN SP	.	.	.	.	.	.	.	T	.	.	T	.	.	.	.	.	.	.	.
ANTE MICR	.	.	.	2	1	.	.	.	.	.	.	.	.	.	T	T	.	.	.
ASTE EATO	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	.	.	.
ASTE INTE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ASTE FOLI	2	2	.	.	.	.	.	T	.	T	.	.	2	2	T	.	1	T	2
CAST MINI	T	.	.	2	.	.	.	2	.	+	.	.	.	.	.	.	.	.	.
CIRS SCAR	.	.	1	1	1	.	.	.	.	.	T	.	1	T	1	+	.	T	.
CYMO SP	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.
EPIL PANI	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
EQUI LAEV	.	T	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
FRAG VIRG	T	2	3	4	2	.	.	.	.	.	2	1	.	2	3	.	.	3	1
GALI BORE	.	.	.	1	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.
GENT AMAR	.	.	T	.	.	.	.	.	.	.	.	.	.	.	T	1	.	.	.
GENT AFFI	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	T	.
GENT DETO	.	.	.	.	.	.	+	.	.	.	.	.	1	.	1	.	.	.	.
GEUM MACR	T	.	.	.	.	.	.	1	3	4	.	T	T	.	.	.	.	2	.
GEUM TRIF	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.
HELE HOOP	1	2	3	2	1	.	.	.	.	+	T	.	1	.	.	.	.	1	.
LINU LEWI	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LUPI LEPI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PEDI GROE	.	.	.	.	.	1	1	.	.	.	.	T	.	.	.	.	.	1	.
PENS SP	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
POLE OCCI	.	.	.	.	.	.	1	4	.	.	.	.	.	.	.	.	.	.	.
POTE GRAC	.	2	2	.	1	.	.	.	.	+	T	.	1	2	2	T	.	1	1
SENE SP	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SMIL STEL	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SWER PERE	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.
TARX OFFI	.	T	.	.	T	.	.	T	.	T	.	T	.	T	.	.	.	1	.
THAL FEND	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
TRIF LONG	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	1
VALE EDUL	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VALE OCCI	.	2	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VIOL SP	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.

	CASI					
	NH 176	SP 158	SP 149a	SP 149	SP 148	IC 25
SHRUBS						
ARTE CANA	.	.	.	.	.	.
BETU GLAN	.	.	.	.	.	.
POTE FRUT	.	.	.	.	.	.
SALX BOOT	.	.	.	.	.	.
SALX WOLF	T	.	1	T	1	1
GRAMINOIDS						
CARX PRAE	.	.	.	.	.	.
CARX DOUG	.	.	.	.	.	.
CARX SCIR	.	.	.	.	.	.
CARX AQUA	.	.	.	.	.	3
CARX LANU	.	.	.	.	.	.
CARX MICR	.	.	.	.	.	.
CARX NEBR	3	3	.	.	.	.
CARX ROST	2	2	2	2	.	T
CARX SIMU	6	4	5	4	4	6
CARX UNK	.	.	.	.	.	.
AGRO CANI	.	.	.	.	.	.
AGRS SCAB	.	.	.	.	.	.
DESC CESP	T	1	.	T	1	T
FEST IDAH	.	.	.	.	.	.
HORD BRAC	.	.	.	.	.	.
JUNC BALT	.	.	.	.	.	.
KOEH SP1	.	.	.	.	.	.
KOEH SP2	.	.	.	.	.	.
PHLE ALP	.	.	.	.	.	.
POA PRAT	T	T	.	T	T	.
STIP COLU	.	.	.	.	.	.
TRIS SPIC	.	.	.	.	.	.
FORBS						
ACHI MILL	.	.	.	.	.	.
AREN SP	.	.	.	.	.	.
ANTE MICR	.	.	.	.	.	.
ASTE EATO	.	.	.	.	.	.
ASTE INTE	.	.	.	.	.	.
ASTE FOLI	.	2	.	.	T	.
CAST MINI	.	.	.	.	.	.
CIRS SCAR	.	.	.	.	.	.
CYMO SP	.	.	.	.	.	.
EPIL PANI	.	.	.	.	.	.
EQUI LAEV	.	.	.	.	3	.
FRAG VIRG	.	.	.	.	.	.
GALI BORE	.	.	.	.	.	.
GENT AMAR	.	.	.	.	.	.
GENT AFFI	.	.	.	.	.	.
GENT DETO	.	1	.	.	.	.
GEUM MACR	.	.	.	.	.	.
GEUM TRIF	.	.	.	.	.	.
HELE HOOP	.	.	.	.	.	.
LINU LEWI	.	.	.	.	.	.
LUPI LEPI	.	.	.	.	.	.
PEDI GROE	.	T	T	T	T	.
PENS SP	.	.	.	.	.	.
POLE OCCI	.	.	.	.	.	.
POTE GRAC	.	.	.	.	.	.
SENE SP	.	.	.	.	.	.
SMIL STEL	.	.	.	.	.	.
SWER PERE	.	.	.	.	1	.
TARX OFFI	.	.	.	.	.	.
TRIF LONG	.	.	.	.	.	.
VALE EDUL	.	.	.	.	.	.
VALE OCCI	.	.	.	.	.	.
VIOL SP	.	.	.	.	.	.

APPENDIX V. LEGEND

LIST OF SPECIES AND ABBREVIATIONS

SHRUBS

ARTE CANA	Artemisia cana
BETU GLAN	Betula glandulosa
POTE FRUT	Potentilla fruticosa
SALX BOOT	Salix boothii
SALX DRUM	Salix drummondiana
SALX EXIG	Salix exigua
SALX LASI	Salix lasiandra
SALX WOLF	Salix wolfii

GRAMINOIDS

AGPR CANI	Agropyron canium
AGRS SCAB	Agrostis scabra
CARX AQUA	Carex aquatilis
CARX DOUG	Carex douglasii
CARX LANU	Carex lanuginosa
CARX MICR	Carex microptera
CARX NEBR	Carex nebrascensis
CARX PRAE	Carex praegracilis
CARX ROST	Carex rostrata
CARX SCIR	Carex scirpoidea
CARX SIMU	Carex simulata
CARX UNK	Carex unknown
DESC CESP	Deschampsia cespitosa
FEST IDAH	Festuca idahoensis
HORD BRAC	Hordeum brachyantherum
JUNC BALT	Juncus balticus
KOEH SP1	Koehleria sp.
KOEH SP2	Koehleria sp.
PHLE ALPI	Phleum alpinum
POA PRAT	Poa pratensis
STIP COLU	Stipa columbiana
TRIS SPIC	Trisetum spicatum

FORBS

ACHI MILL	Achillea millefolium
AREN SP	Arennaria sp.
ANTE MICR	Antennaria microphylla
ASTE EATO	Aster eatonii
ASTE FOLI	Aster foliaceus
ASTE INTE	Aster integrifolius
CAST MINI	Castilleja miniata
CIRS SCAR	Cirsium scariosum
CYMO SP	Cymopterus sp.
EPIL PANI	Epilobium paniculatus
EQUI LAEV	Equisetum laevigatum
FRAG VIRG	Fragaria virginiana
GALI BORE	Galium boreale
GENT AFFI	Gentiana affinis
GENT AMAR	Gentianella amarella
GENT DETO	Gentianella detonsa
GEUM MACR	Geum macrophyllum
GEUM TRIF	Geum triflorum
HELE HOOP	Helenium hoopesii
LINU LEWI	Linum lewisii
LUPI LEPI	Lupinus lepidus
PEDI GROE	Pedicularis groenlandica
PENS SP	Penstemon sp.
POLE OCCI	Polemonium occidentale
POTE GRAC	Potentilla gracilis
SENE SP	Senecio sp.
SMIL STEL	Smilacina stellata
SWER PERE	Swertia perennis
TARX OFFI	Taraxacum officinale
THAL FEND	Thalictrum fendleri
TRIF LONG	Trifolium longipes
VALE EDULL	Valeriana edulis
VALE OCCI	Valeriana occidentalis
VIOL SP	Viola sp.

APPENDIX VI. Constancy and (Average Coverage Percent) of Important Species

	ARCA/FEID	POFR/DECE	SAWO/POPR	SAWO/SWPE	JUBA	CASI	CARO
# of Stands	13	6	2	2	6	6	3
SHRUBS							
ARTE CANA	10 (30)	7 (1)	10 (10)	-	3 (**)	-	-
BETU GLAN	-	-	-	10 (10)	-	-	-
POTE FRUT	5 (7)	10 (29)	5 (12)	-	2 (**)	-	-
SALX BOOT	+ (**)	2 (**)	-	-	3 (**)	-	7 (1)
SALX WOLF	5 (2)	2 (2)	10 (41)	10 (16)	2 (**)	8 (1)	3 (**)
GRAMINOIDS							
CARX SP	-	-	-	-	2 (5)	-	-
CARX AQUA	-	-	-	-	-	2 (4)	7 (22)
CARX DOUG	+ (2)	3 (4)	-	-	3 (8)	-	-
CARX LANU	2 (**)	-	5 (6)	-	-	-	-
CARX MICR	5 (6)	7 (4)	5 (5)	-	3 (**)	-	7 (3)
CARX NEBR	-	-	-	-	2 (5)	3 (11)	-
CARX PRAE	1 (**)	5 (10)	-	-	5 (4)	-	-
CARX ROST	-	-	-	-	2 (3)	8 (10)	10 (74)
CARX SCIR	-	3 (2)	-	-	-	-	-
CARX SIMU	-	3 (**)	-	10 (78)	-	10 (78)	-
AGRO CANI	9 (2)	10 (6)	10 (2)	-	7 (**)	-	3 (**)
AGRS SCAB	2 (**)	-	2 (**)	-	-	-	-
DESC CESP	4 (1)	10 (31)	7 (3)	10 (**)	10 (2)	8 (1)	7 (10)
FEST IDAH	9 (21)	2 (3)	10 (11)	-	2 (**)	-	-
HORD BRAC	2 (**)	5 (2)	-	-	3 (**)	-	3 (**)
JUNC BALT	5 (5)	8 (7)	5 (**)	5 (18)	10 (67)	-	3 (**)
KOEH SP1	5 (**)	5 (1)	2 (**)	-	-	-	-
KOEH SP2	1 (**)	-	-	-	-	-	-
PHLE ALPI	5 (1)	2 (**)	7 (**)	-	8 (1)	-	-
POA PRAT	6 (1)	8 (1)	7 (1)	-	10 (1)	7 (**)	7 (5)
STIP COLU	5 (**)	2 (2)	-	-	-	-	-
TRIS SPIC	1 (**)	-	-	-	-	-	-
FORBS							
ACHI MILL	9 (3)	10 (2)	7 (1)	-	7 (1)	-	7 (1)
AREN SP	1 (**)	-	-	-	-	-	3 (**)
ANTE MICR	5 (1)	3 (2)	5 (2)	-	3 (**)	-	-
ASTE EATO	1 (**)	2 (1)	-	-	2 (1)	-	-
ASTE INTE	+ (**)	-	-	-	-	-	-
ASTE FOLI	4 (3)	7 (8)	2 (1)	-	8 (4)	3 (3)	7 (**)
CAST MINI	-	-	2 (2)	-	-	-	3 (3)
CIRS SCAR	5 (**)	8 (1)	7 (1)	-	7 (**)	-	-
CYMO SP	-	-	-	-	3 (**)	-	-
EPIL PANI	4 (**)	-	2 (**)	-	-	-	-
EQUI LAEV	-	2 (**)	2 (**)	5 (**)	-	2 (4)	-
FRAG VIRG	9 (19)	10 (8)	10 (25)	-	7 (11)	-	-
GALI BORE	1 (**)	-	2 (1)	-	-	-	3 (**)
GENT AFFI	2 (**)	3 (**)	2 (1)	-	3 (**)	-	-
GENT AMAR	-	-	2 (**)	-	3 (**)	-	-
GENT DETO	+ (**)	2 (**)	-	+	-	-	-
GEUM MACR	1 (**)	-	-	-	2 (2)	-	10 (30)
GEUM TRIF	5 (1)	-	-	-	-	-	-
HELE HOOP	10 (25)	7 (4)	10 (12)	-	2 (**)	-	-
LINU LEWI	4 (**)	-	2 (**)	-	-	-	-
LUPI LEPI	-	3 (**)	-	-	-	-	-
PEDI GROE	+ (**)	2 (**)	-	10 (1)	2 (**)	7 (**)	-
PENS SP	5 (1)	-	-	-	-	-	-
POLE OCCI	-	-	-	5 (**)	-	-	3 (17)
POTE GRAC	8 (3)	8 (4)	7 (5)	-	8 (4)	-	-
SENE SP	1 (**)	-	-	-	-	-	-
SMIL STEL	-	2 (2)	-	-	-	-	-
SWER PERE	-	-	-	10 (4)	-	-	-
TARX OFFI	1 (**)	3 (**)	2 (**)	-	3 (1)	-	7 (**)
THAL FEND	2 (**)	-	2 (**)	-	-	-	-
TRIF LONG	2 (**)	3 (**)	2 (**)	-	3 (**)	-	-
VALE EDUL	5 (4)	5 (1)	-	-	-	-	-
VALE OCCI	-	-	5 (4)	-	-	-	-
VIOL SP	1 (**)	2 (**)	2 (**)	-	2 (**)	-	-

Legend: Trace Coverage = **
Constancy : + = 0-5%, 1 = 6-15%, 2 = 16-25%, 3 = 26-35%, 4 = 36-45%, 5 = 46-55%, 6 = 56-65%, 7 = 66-75%, 8 = 76-85%, 9 = 86-95%, 10 = 96-100%

AD-33 Bookplate
(1—63)

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